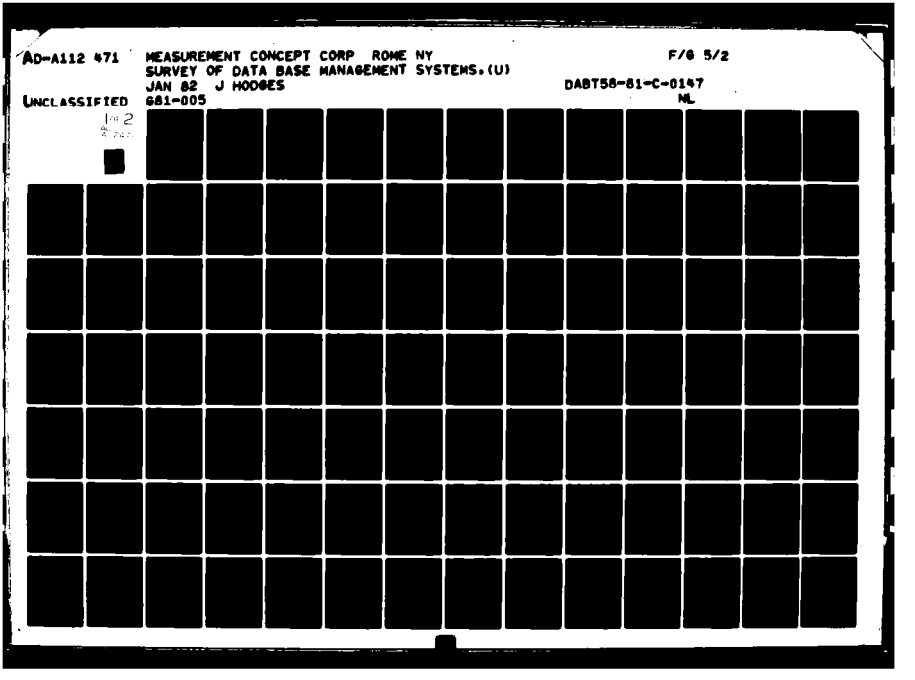
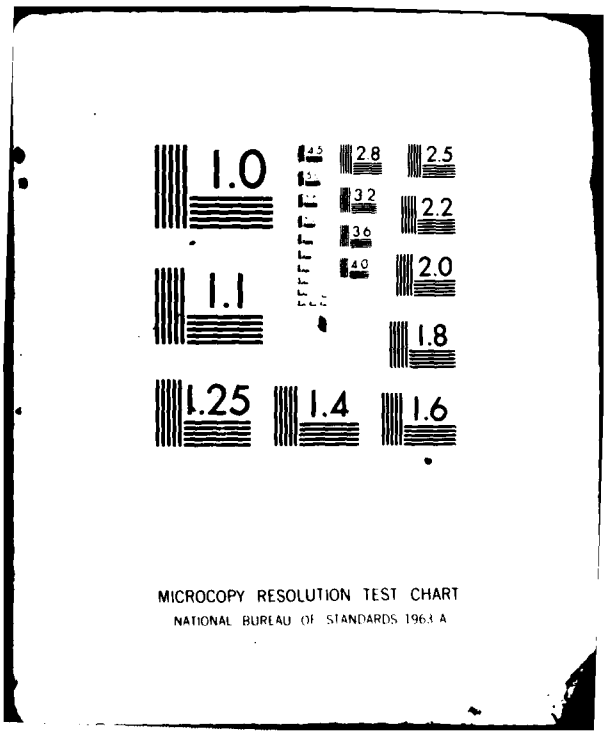
AD-A112 471 MEASUREMENT CONCEPT CORP ROME NY F/G 5/2
SURVEY OF DATA BASE MANAGEMENT SYSTEMS.(U)
JAN 82 J HODGES DABT58-81-C-0147
UNCLASSIFIED G81-005 NL




1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When D

AD A112471

REPORT DOCUMENTATIC ORM

| 1. REPORT NUMBER | 2. GOVT ACCESSION NO. | 3. RECIPIENT'S CATALOG NUMBER |
|---|---|---|
| G81-005 | AD-A112 471 | |

| 4. TITLE (and Subtitle) | 5. TYPE OF REPORT & PERIOD COVERED |
|---|---|
| Survey of Data Base Management Systems | Final Technical Report 9/23/81 - 1/22/82 |
| | 6. PERFORMING ORG. REPORT NUMBER |
| 7. AUTHOR(s) | 8. CONTRACT OR GRANT NUMBER(s) |
| John Hodges | DABT 58-81-C-0147 |
| 9. PERFORMING ORGANIZATION NAME AND ADDRESS | 10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS |
| Measurement Concept Corporation<br>1721 Black River Road<br>Rome, NY 13440 | DA0G 9543 |
| 11. CONTROLLING OFFICE NAME AND ADDRESS | 12. REPORT DATE |
| U.S. Army Training & Doctrine Command<br>ATTN: ATCD-AU<br>Fort Monroe, VA 23651 | Jan 82<br>13. NUMBER OF PAGES<br>155 |
| 14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) | 15. SECURITY CLASS. (of this report) |
| U.S. Army Combined Arms Combat Development Activity<br>ATTN: ATZL-CAN-DO<br>Fort Leavenowrth, Kansas 66027 | Unclassified<br>15a. DECLASSIFICATION/DOWNGRADING SCHEDULE |

16. DISTRIBUTION STATEMENT (of this Report)

Approval for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number) EVALUATION, TOTAL FORCE, CSS, MANAGEMENT, SIMULATION, OPERATIONS PLANNING MODELS, COEA, MODELS, DATA BASE, DATA BASE MANAGEMENT SYSTEM, DATA, ARMY ANALYSIS, COMBAT DEVELOPMENTS, SIMULATIONS, WARGAMES, THREAT DATA, MODEL MANAGEMENT, DATA BASE MANAGEMENT, ARMY MODEL IMPROVEMENT PROGRAM, AMIP, AMMO, CASTFOREM, FORCEM, CORDIVEM, SOFTWARE, HARDWARE, ADPE, DATA ITEMS

20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report surveyed the input data required for the primary Amip models: the Force Evaluation Model (FORCEM); the Corps and Division Evaluation Model (CORDIVEM); and the Combined Arms and Support Task Force Evaluation Model (CASTFOREM). This survey developed a methodology to evaluate commercially available Data Base Management Systems (DBMS) that are candidates for managing AMIP data. The evaluation of the models and data requirements indicates that the volume of AMIP data is not a serious consideration for selection of a DBMS. The data on Red and Blue Forces is represented in the three models surveyed in its own unique way. (Continued)

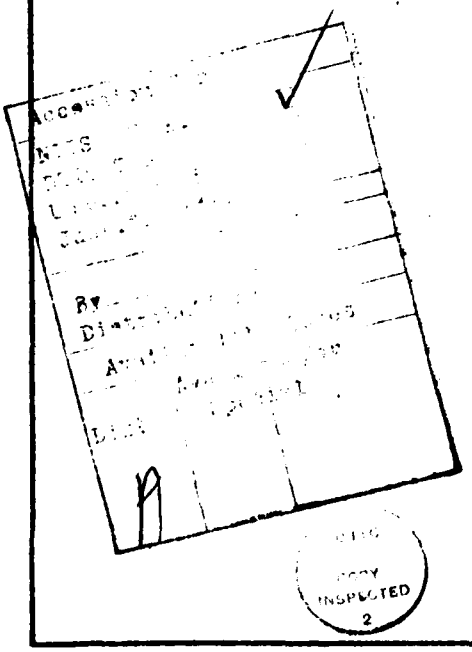
DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

19. (continued)

Although some candidates for commonality of data were identified, no common data items exist among the models under the current plans for development. From examination of overall DBMS evaluation criteria, the SQL/DS system ranks highest; however, due to cost constraints and technical risks of SQL/DS the DBMS DMS-1100 is recommended as the AMIP DBMS. But there are some difficulties identified with this choice; a second alternative, then, is System 2000.



COPY INSPECTED 2

# SURVEY OF DATA BASE MANAGEMENT SYSTEMS

## FINAL TECHNICAL REPORT

Contract No.: DABT58-81-C-0147

G81-005

January 1982

Prepared For:

Department of the Army
CACDA Attn: ATZL-CAN-DO
Fort Leavenworth, Kansas 66027

82-2363

MEASUREMENT CONCEPT CORPORATION
ROME, NEW YORK 13440

82

TABLE OF CONTENTS


| | | Page |
|---|---|---|
| 1.0 | INTRODUCTION AND BACKGROUND. . . . . | 1-1 |
| 1.1 | Executive Summary. . . . . | 1-1 |
| 1.2 | The Models . . . . . | 1-2 |
| 2.0 | AMIP MODEL DATA BASE REQUIREMENTS . . . . . | 2-1 |
| 2.1 | Overall Volume of Data Required for AMIP Models . | 2-1 |
| 2.2 | Force Description Representation . . . . . | 2-4 |
| 2.3 | Tactical Aircraft and Air Defense Representation . | 2-11 |
| 2.4 | Non-US Blue Forces Representation . . . . . | 2-13 |
| 2.5 | Doctrinal vs. Fiscally Constrained Forces . . . . | 2-13 |
| 2.6 | Performance Representation . . . . . | 2-14 |
| 2.7 | Environmental Data Representation . . . . . | 2-14 |
| 3.0 | DBMS SURVEY AND EVALUATION . . . . . | 3-1 |
| 3.1 | DBMS Survey . . . . . | 3-1 |
| 3.2 | DBMS Evaluation . . . . . | 3-75 |

LIST OF FIGURES


| | | Page |
|---|---|---|
| 1-1 | FORCEM Genealogy . . . . . | 1-5 |
| 1-2 | ICOR Genealogy . . . . . | 1-8 |
| 1-3 | CASTFOREM Genealogy . . . . . | 1-12 |
| 1-4 | General Data Flow . . . . . | 1-14 |
| 1-5 | CAA Current DBMS Capability . . . . . | 1-15 |
| 1-6 | CASAA Current DBMS Capability . . . . . | 1-16 |
| 1-7 | TRASANA Current DBMS Capability . . . . . | 1-17 |
| 2-1 | Comparative Size of AMIP Data Bases . . . . . | 2-3 |
| 2-2 | Force Description: Unit Locations . . . . . | 2-5 |
| 2-3 | AMIP Force Description: Unit Designations . . . . | 2-6 |
| 2-4 | AMIP Force Description: Force Structure & Composition | 2-8 |
| 2-5 | Force Description: Force Structure Level . . . . | 2-9 |
| 2-6 | Force Description: Unit and System Types . . . . | 2-10 |
| 2-7 | CASTFOREM Air Defense Assessment Process . . . . . | 2-12 |
| 2-8 | AMIP Representation of Killer-Victim Scoreboards . | 2-15 |
| 2-9 | Killer-Victim Scoreboards . . . . . | 2-16 |
| 2-10 | AMIP Model Operations, Performance & Support Interface | 2-17 |
| 2-11 | AMIP Terrain Data Representation . . . . . | 2-18 |
| 2-12 | AMIP Model Climatic Data . . . . . | 2-19 |
| 2-13 | AMIP Data Base Requirements for Terrain . . . . . | 2-21 |
| 3-1 | DBMS as a Control Vehicle for Stand. of Data Elements | 3-80 |

# 1.0 INTRODUCTION AND BACKGROUND

## 1.1 Executive Summary

This report deals with a survey of the data required as input to the primary AMIP models (the Force Evaluation Model (FORCEM), a theater force model used by the Concepts Analysis Agency (CAA); the Corps and Division Evaluation Model (CORDIVEM), a corps and division model used by the Combined Arms Combat Development Activity (CACDA); and the Combined Arms and Support Task Force Evaluation Model (CASTFOREM), a combined arms task force model used by the TRADOC Systems Analysis Activity (TRASANA)) and with a survey of commercially available Data Base Managaement Systems (DBMSs) which are candidates for managing these data.

### 1.1.1 AMIP Model Data Base Requirements

In each case it was found that agency study directors assemble input information specifically for each study and then create data bases for the models to be used. The distinction between study requirements and model requirements is subtle but important in its impact upon data base requirements. The maximum data base requirement for the three major AMIP models approximates 430 megabytes with all data items being unique to one, and only one, model. Such uniqueness is due to differences in designation of units, location of units and battlefield features, differences in levels of resolution, and some conflicting definitions among the models. Existence of such differences is not surprising in view of the absence of an overall model development philosophy and policy.

### 1.1.2 Data Base Management Systems

Eight commercial DBMSs and a data base machine were evaluated to identify the candidate that best meets AMIP data base management needs. Five of

the DBMSs are compatible with the Univac 1100/80/82 in residence at the three agencies, one with PDP-11 and VAX-11, one with IBM, and one with Honeywell computers. The data base machine is being configured for use with Univac 1100 computers. In every case it was determined that functional capabilities associated with control and management of characteristics and contents of the data base were of more importance than performance efficiency and capacity. All of the candidates surveyed have adequate capacity and none of the agencies is, at present, taxing the CPU capacity of the Univac 1100. Because of this, selection of a DBMS can be made on the basis of the best combination of management and control features offered by the candidates. This is highly to be desired due to the numerous sources of data, the varying formats and subsets of data required by the models, and the numerous versions of the data required by the users of the models. It also is compatible with the stated Army goal of implementing a standard data format so that all users may extract their data needs from a well-established repository having known characteristics. Control of format, control of access for read, use, or update, and accountability for validity of contents are included features.

### 1.1.3 Selection Criteria

Evaluation criteria were developed from definitions of desired DBMS functions and their relative importance to AMIP needs. The resulting array is shown in the first table of the Evaluation Scores (paragraph 3.2.3). The other criterion for selection was total cost of implementation.

### 1.1.4 Recommendations

It is recommended, with certain reservations, that the Univac DMS-1100 be adopted as the AMIP DBMS. Reservations concern the difficulty of data base design in the CODASYL data model resident in DMS-1100. The degree to which such difficulty poses a real, rather than a perceived, problem requires definition.



5

## 1.2 The Models

Arms and support models, together with automated war games, form the basis for Army analytical studies of complex force interactions in battlefield environments. These models have been developed in response to the requirements of specific agencies or specific study applications. Consequently, there has been little systematic development, documentation, consistency, validation, or long-term direction. Existing Army models tend to be complex and sophisticated, focusing on weapons characteristics and performance, rather than on such battlefield functions as logistics, casualty estimation, force reconstitution, command, control, communication and intelligence ($C_3I$), electronic warfare (EW) and engineer support.

A review of Army analysis was begun in 1978 with the objective of evaluating Army analysis capabilities and proposing improvements. Recommendations included development and implementation of a family of structured combat and support models with an integrated data base. The program which grew out of these recommendations was named the Army Model Improvement Program (AMIP). Subsequently, an AMIP Management Office (AMMO) was established at Ft. Leavenworth, KS.

Under this program, three versions of the models are to be developed:

- Automated combat and support simulations.
- Interactive, man-in-the-loop, computer-assisted war games.
- Training games run manually or without computer support.

Automated simulations are to be employed when a rapid response to Army study requirements is required. Interactive war games are used to gain insights into combat processes and force structures, to evaluate potential new weapon systems, to interface with the simulations, and ultimately to

interface with the training games. Training requirements will dictate the need for and character of the training versions.

Although weapons performance remains important, processes and activities incident to a weapon's firing will be featured in the modeling, which will include all levels of operations and their supporting functions and services. The hierarchy of combined arms and support simulation models is seen as an integrated family of analytical tools with three major components: FORCEM, CORDIVEM, and CASTFOREM.

### 1.2.1 FORCEM

The FORCEM component will address the issues of alternatives for improved force readiness, design of theater force structure, and determination of theater resources required for sustained combat operations. FORCEM development will take the shape of a series of modular steps in making a planned transition from the current theater model, CEM-V, to the FORCEM model. As CEM modules are replaced or new modules are added, the model will gradually change in structure and operation while constantly remaining available for CAA studies. The effects of the modular changes can thus be examined in a stepwise fashion as the program develops an end product bearing little resemblance to CEM. The areas to be improved include $C_2$, intelligence, communications, maneuver/[illegible], [illegible]tronic warfare, combat support, combat service support, air operations, and environment.

#### 1.2.1.1 CEM

The Concept Evaluation Models (CEM) are theater simulations of conventional war which have evolved from Kriegspiel, the manual wargame developed for the German General Staff in the 1930s (see Figure 1-1). In CEM-V the battle area is divided into corps sectors with sub-sectors for brigades on the Blue side and divisions on the Red side. Attrition is



7

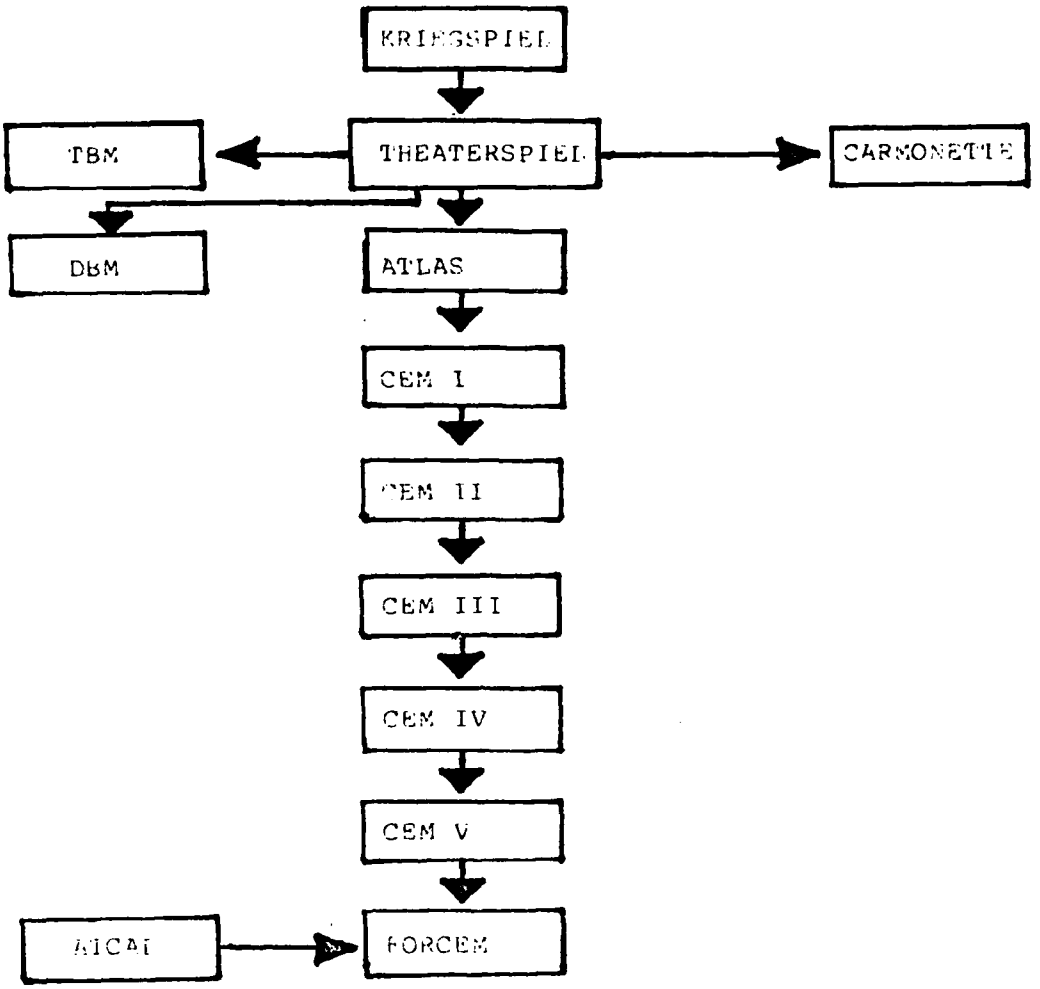



Figure 1-1. FORCE Genealogy.

calculated by the use of a force ratio index number that involves Weapon Evaluation Indices/Weighted Unit Values (WEI/WUV) scores. Terrain is treated in aggregated bands across sub-sectors. Supplies are explicitly treated. Penetrations can be treated to a limited degree with allocation of forces to flanks. The maximum number of types of units is 50. The force being simulated can contain up to eight different types of cannon. Direct support artillery is assigned to brigades/regiments. Time periods are: corps, one day; army, two days; theater, four days. Shortage of supplies can affect outcomes. There are two notional aircraft types per side. There is an explicit command structure with decisions made according to decision rules based on force ratios and unit status. Three postures are available to units; attack, defend, delay. Modifications of the model have been developed for study of reinforcements, supplies, and casualties (WARAMP).

1.2.1.2 Data Base

Data base development for the FORCEM model falls into at least four areas as outlined below:

- Force Data. Work has begun on development of an automated management system for theater force data drawing from standard Army sources such as TOE and the Force Accounting System.

- Environment Data. Demographic data (population, terrain, average weather, climate) will be drawn from standard references, as they are essentially stable and require less elaborate data management provisions. Other environmental data, such as local weather and battlefield obscuration, will be volatile, will be supplied by lower level models, and will require more elaborate data management provisions.

- o Performance Data. The theater model will not normally portray individual systems explicitly. Most performance data will be received from higher resolution models or functional area models as calibration data. Procedures for identifying, storing, and retrieving desired data must be developed.

- o Situation Data. Data for specification of theater force organization and concept of operation must be developed to include incorporation of decision logic and command policies that could affect the outcome. Again, situation reports from higher resolution models will be an important part of the situation data input for FORCEM.

### 1.2.2 CORDIVEM

The CORDIVEM Model will be corps level in scope with the capability of simulating a division or a corps. Its primary use will be to supply information for design and force structure trade-off analyses of Army organizations such as brigades, divisions, and corps. A secondary use will be in support of studies of systems normally organic to major organizations. CACDA is developing the CORDIVEM Model by making a composite model from desirable elements of the ICOR Model and other models resident at CACDA.

#### 1.2.2.1 ICOR

The TCOR simulations (CLEW II, ICOR, TCOR, WARRANT) are a family of simulations of corps level operations (see Figure 1-2). They have been designed to be applied to a variety of analyses including nuclear weapon use, interdiction, sensor systems, and command and control. The battle area is laid out on a hexagonal coordinate system allowing two-dimensional movement of forces. Penetration, encirclement, and over-run are explicitly represented. Attrition is calculated by a modified Lanchester

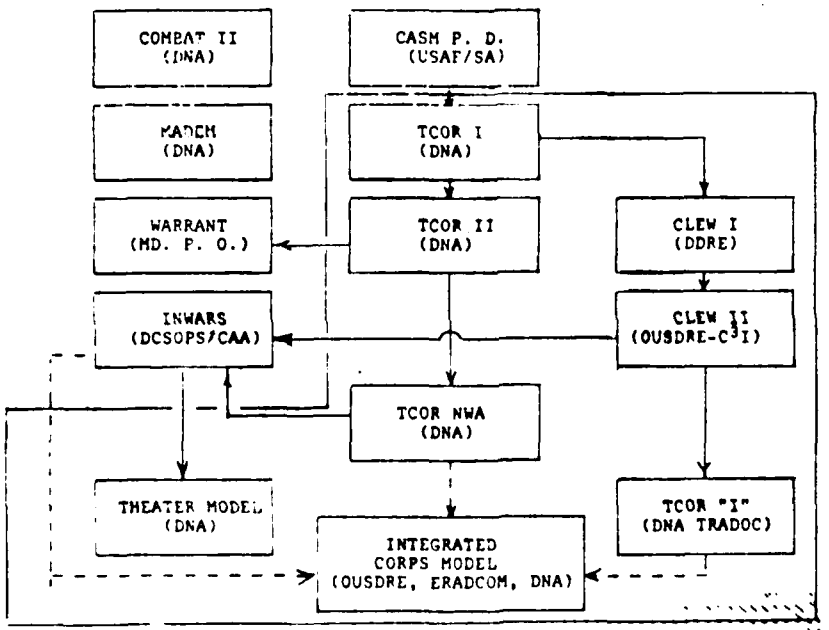



Figure 1-5. TCOR Genealogy.

equation including suppression, visibility, terrain, and other factors. The model is operated interactively with the operator (force commander) on each side being presented with information from representations of sensor systems and from status reports on his own forces. The ground forces operate by the operations reaction system that responds to orders given, the status of the unit postured, and the situation. The time interval (usually five minutes simulated time) is the actual calculation time for events simulated. Weapon types are specific. Units move by operations codes and are affected by terrain, suppression, massing, and perceived threat. Artillery is represented by specific location of batteries. Artillery missions include target servicing indirect fire (TSIF), counterfire, interdiction, and suppression of enemy air defense. Air support is represented by a notional air base from which sorties are generated by the operator. Aircraft types include helicopters. Air defense is explicit. Intelligence sensors are generic or specific depending on the version of the simulation. For explicit sensors (IMINT, SIGINT, and maneuver unit acquisition - air and ground) the information is processed and presented to the appropriate level of command. Logistic support is explicit for both conventional and nuclear operations. Command and control links exist from corps through battalion.

#### 1.2.2.2 CACDA Terrain Model

The CACDA terrain model incorporates a digitized representation of terrain which is used to give the operator a realistic visual image of the terrain upon which the battle is fought.

#### 1.2.2.3 Force Organization Control System (FOCS)

The FOCS is a system for managing force organization data which includes 15 different types of TOE and related data along with changes in numbers and status of TOE items as a result of simulated combat.



12

1.2.2.4 Data Base

Data base development includes descriptions of the battlefield environment, the forces, and system and unit performance factors.

- Surface Description. Surface description data include elevation values of local surface features, road and rail nets, hydrography, and off-road mobility potential. Data for the initial geographic area within the Federal Republic of Germany (FRG) were completed in late 1980 and other areas are planned. Digitization of terrain data is proceeding more slowly.

- Climatic Description. The U.S. Army Atmospheric Sciences Laboratory is developing climatic data for areas of interest. The data include cloud conditions, visibility, temperature, winds, precipitation and other climate factors. The data will be organized into weather regions for hourly conditions and will be available for Mod II application in late 1983.

- Force Description. Data to describe force composition, unit composition, echelonment, command relationships, and other scenario-related information will be developed for both sides. The data will define the force elements modeled and their battlefield activities. The preliminary data structures and processing algorithms in the Force Organization and Control System (FOCS) developed by CASAA will be modified to meet functional design requirements.

- System and Unit Performance. The most critical item in the CORDIVEM development is definition of scope and detail of events, activities, and processes that model battlefield functions. These data define unit operational capability and performance profiles for battlefield systems, quantification of tactics and doctrine, and interfaces and interactions among modeled units and systems, and with the battlefield environment.

### 1.2.3 CASTFOREM

The CASTFOREM component will be task force level in scope and will represent the detailed combat operations of the combined task force and its support to determine the effectiveness of units and item systems. It will also record the approximate level of personnel and equipment attrition and the magnitude of resources consumed in the course of the task force operations.

#### 1.2.3.1 BESS

The Battlefield Engagement Stochastic Simulation (BESS), under development at TRASANA, will serve as the basis for CASTFOREM (see Figure 1-3). CASTFOREM Mod I (BEST) was demonstrated in October 1980, and the CASTFOREM II design phase was completed in April 1981. Mod III design specifications will expand upon those of Mod II and will include aviation, engineer, artillery, and combat service support representation. Specific depictions are made of nearly all battlefield functions (close combat, fire support, air defense, combat support, combat service support, communications, command and control, intelligence and electronic warfare) and the battlefield environment.

#### 1.2.3.2 Data Base

Data base development for CASTFOREM was started in August 1980 and is well on the way to completion. Documentation of the model proceeds apace with model development. The data base for CASTFOREM is characterized by extremely fine detail on items, systems, and units with a complete audit trail to the origin of each bit of data.

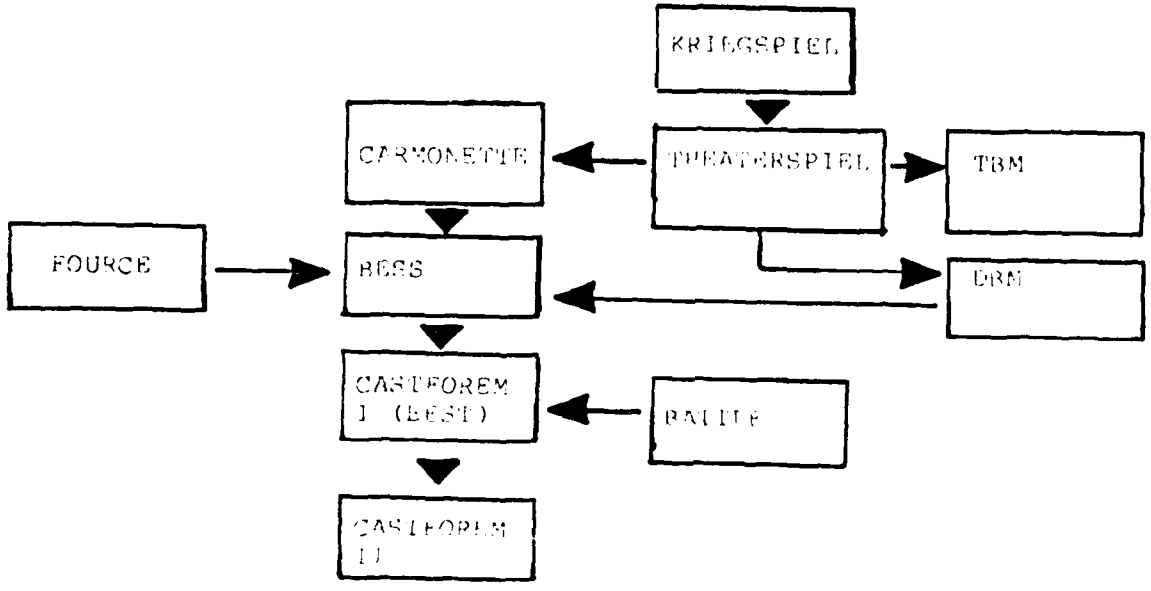



Figure 1-3. CASTFOREM Genealogy.

## 1.3 Data Flow

The flow of data within the Army modeling agencies is exemplified by Figure 1-4. All agencies maintain a certain amount of data in-house which is largely non-volatile. External data sources are consulted to complete the information requirements for a specific study. The agencies then manually transform the collected information into data for input to a specific model. Such transformation entails specific formatting, naming, listing, and dimensioning to meet the design characteristics of each model. This survey has examined the contents of the boxes labeled "Study Data File", "Study Input Rqmts", and "Model Rqmts" in Figure 1-4.

## 1.4 Data Base Management

### 1.4.1 Current AMIP Data Base Management Systems

All three AMIP agencies currently have Data Base Management Systems (DBMS) which they are essentially not using to manage AMIP data. CAA has a DMS 1100 and a MIRADS (Figure 1-5) which are used for administrative and accounting purposes and for managing some study related data, but not data related to FORCEM (or CEM V). Instead, separate study data files, most with essentially redundant data, are maintained for each study conducted. CASAA shares the availability of DBMSs with other organizations at Ft. Leavenworth. As Figure 1-6 indicates, System 2000, QUERY/UPD and DMS 1100 are currently available at Ft. Leavenworth but essentially not used for AMIP type data management. (Although the System 2000 is used to support analyses by managing and cross-referencing library documents). TRASANA has a DMS 1100 that is used for document retrieval, but not otherwise used for data base management.

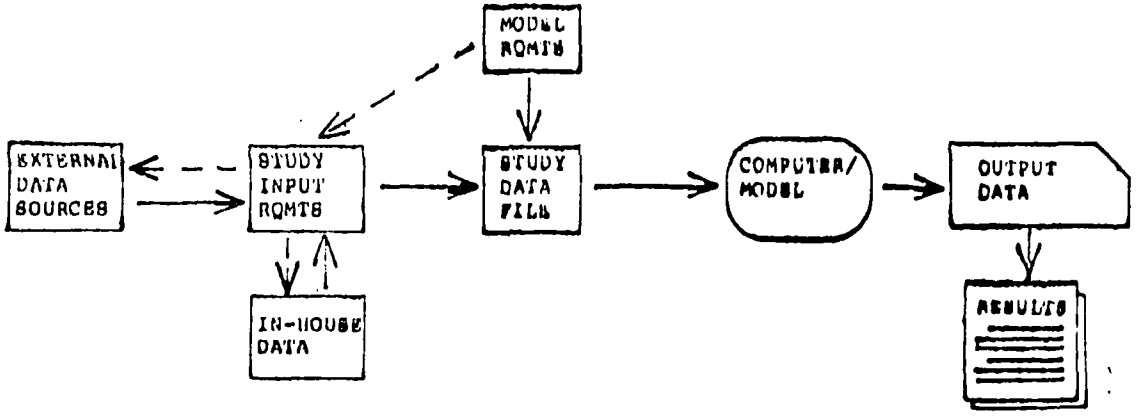



Figure 1-4. General ... Flow.

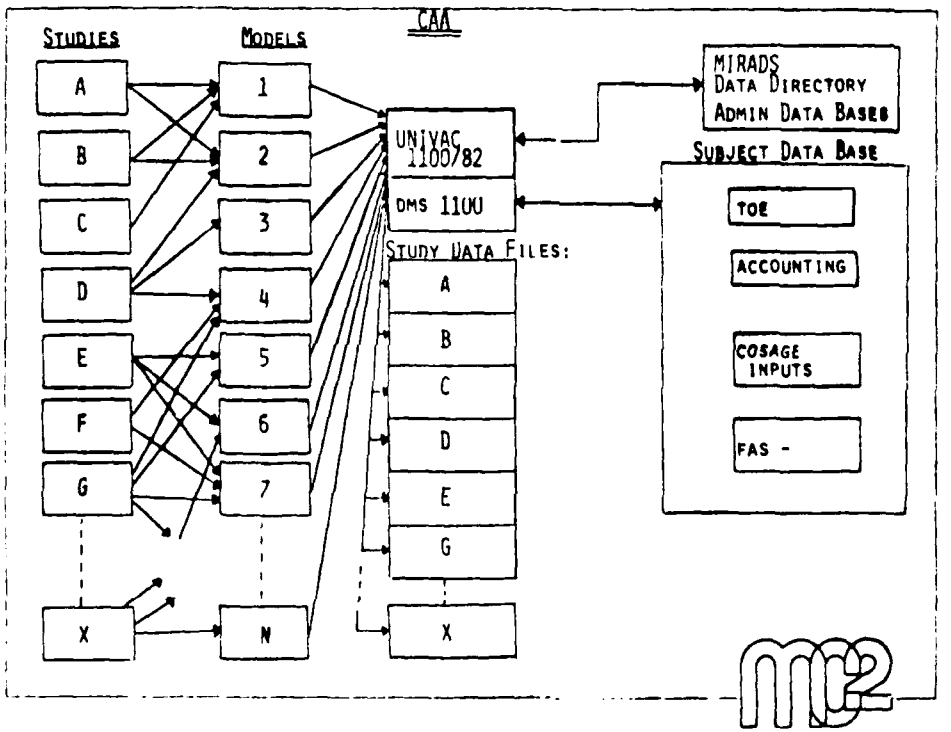



Figure 1-5. CAA Current DBMS Capability.

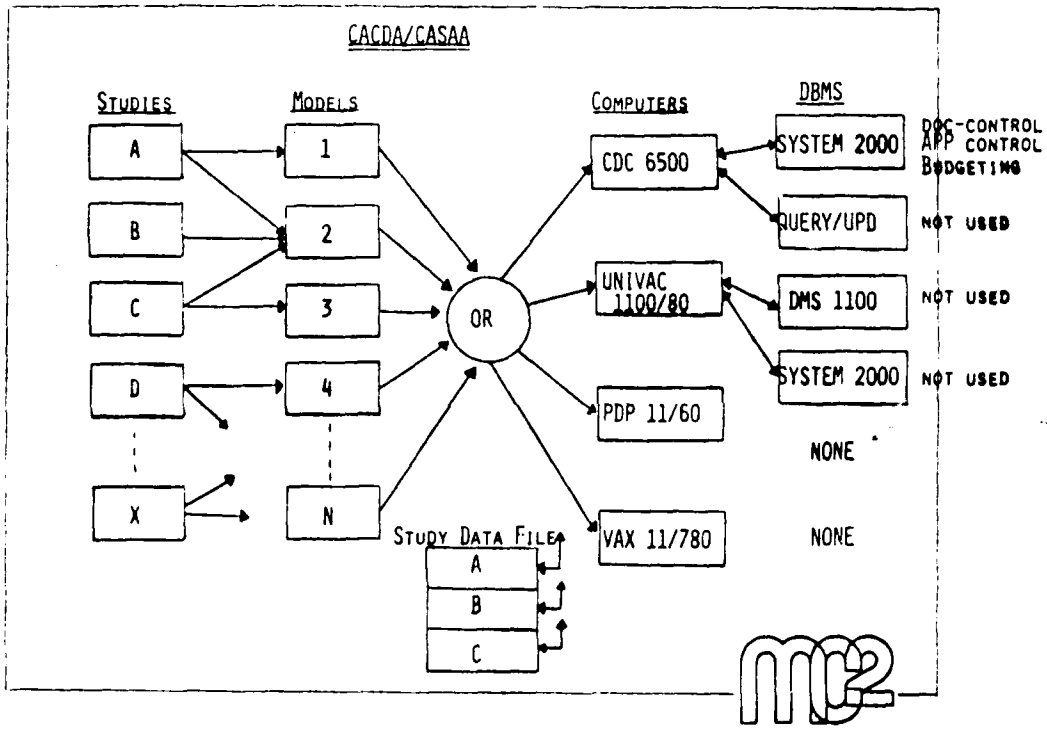



Figure 1-6. CACDA Current DBMS Capability.

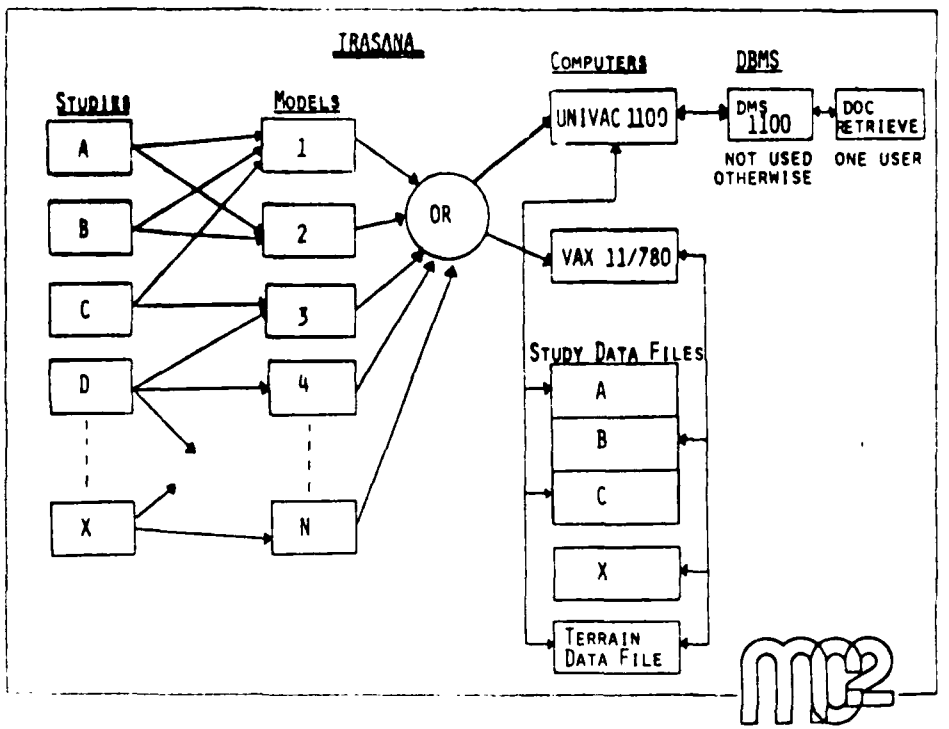



Figure 1-7. IRASANA Current DBMS Capability.

### 1.4.2 Future AMIP DBMS Potential - Advantages and Disadvantages

Currently, CAA, CASAA and TRASANA keep essentially redundant data "files" of records for each study application. The intent of a data base is to allow that same collection of data to serve as many applications as is useful. Hence, a data base may be conceived of as the repository of information needed for running certain functions within and among the Army agencies. Such a data base would permit not only the retrieval of data, but also its continuous modification as needed to support the Army modelling effort. It would also permit "tagging" each data item to maintain an account of its precise origin and meaning (Data Dictionary and Directory), and could ensure commonality of certain data among the studies.

It is a much publicized dream of managers to have a centralized agency data base in a large reservoir in which a diversity of data users can go fishing. Such a data base may be highly complex, and in general the dream may be far from being achieved in reality; but it should remain a worthy goal of data processing in the future. A complex data base has to be built up stage by stage. In reality today most data bases serve a varied, but limited, set of applications.

A major task for the Army during this decade is to decide what data bases it needs, where they are best located, what data should be stored in them, and how they should be organized. Beginning with the Hardison Report, and continuing efforts such as this survey, the Army Model Improvement Program is beginning to address its part of this major Army task.

## 2.0 AMIP MODEL DATA BASE REQUIREMENTS

### 2.1 Overall Volume of Data Required for AMIP Models

#### 2.1.1 CASTFOREM

Although data requirements for CASTFOREM are heavily scenario and user requirements dependent (more so than the other two AMIP models), the total data base will probably be 12 to 13 megabytes (mb), including all the program codes and environmental data, as well as the input data. This model differs from the other two AMIP models in terms of data requirements because much of its input data will be provided by the user of the resulting study, or will be generated internally by TRASANA (based on previous studies), for approval by the user. Examples include; the Decision Tables, Combat Orders, Primitive Orders, CSS and Engineer Techniques, the search doctrine, and much of the Type Unit input data. Of the remaining input data, it is estimated that only approximately ten percent will require update from outside agencies such as AMSAA. TRASANA has a large terrain data base covering approximately 63,000 $KM^2$ on tapes. Each tape contains terrain data for a typical CASTFOREM analysis (approximately 20 x 20 KM). At the terrain resolution required by CASTFOREM, 9600 bytes are required per square KM, or about four megabytes per battalion task force study.

#### 2.1.2 CORDIVEM

Because CORDIVEM will be an interactive model, a large portion of its input data will be provided by the players during the analysis. The current baseline configuration will require about ten mb, but the production model is expected to consist of over 416 mb. Most of this data (336 mb) will be required for game history in support of the player interface. Of the 80 mb remaining, digitized terrain consumes most (72 mb). The 72 mb will probably not be on line. This is only the European Terrain and it does not include the lines of communication/hydrography, nor the HEX data bases, that are presently in the ICOR data base. The HEX

data base will be expanded both in size and to other geographical areas. Figure 2-1 depicts the relative volume of data that is forecast to be in each of the AMIP model data bases. From the chart it is clear that CORDIVEM will have the largest data base (excluding the large accumulation of terrain data at TRASANA). The Red/Blue forces data base and the ICOR core resident static and dynamic data base constitute about one megabyte each. Weapon effectiveness data (planned as input from CASTFOREM) are expected to consume less than 400 kilobytes. Updating of the CORDIVEM data base will probably consist of about 10 percent of the Red/Blue Force Organization (about 102 kilobytes) and probably all the inputs from CASTFOREM (390 kilobytes). These constitute an estimated total update requirement of about one-half a megabyte each time a major study is initiated using CORDIVEM.

### 2.1.3 FORCEM

FORCEM will likely have the smallest data base of the three AMIP models (about 365 kilobytes), but require the largest input data updates. This is because the theater model is sensitive to a broader range of variables. It is used to assess changes in fiscal appropriations (and therefore is sensitive to the POM Cycle), as well as changes in employment doctrine (reflecting a sensitivity to TRADOC doctrinal force inputs), and changes in Red/Blue performance results (i.e., Killer/Victim Scoreboards). Currently, the CAA data base which will later be reflected in FORCEM has a minor update every two-to-four months when a new major study is initiated, and a major update annually when the new outyear force of the FYDP is defined.

### 2.1.4 Conclusion

The maximum data base requirements for all the AMIP models is expected to be about 430 megabytes ... assuming that no data are duplicated in more than one model. Because all commercial DBMSs under consideration have a data base handling capacity in the billions of bytes (for example, ADABAS-M has a maximum capacity of $8 \times 10^{12}$ bytes), it can be concluded

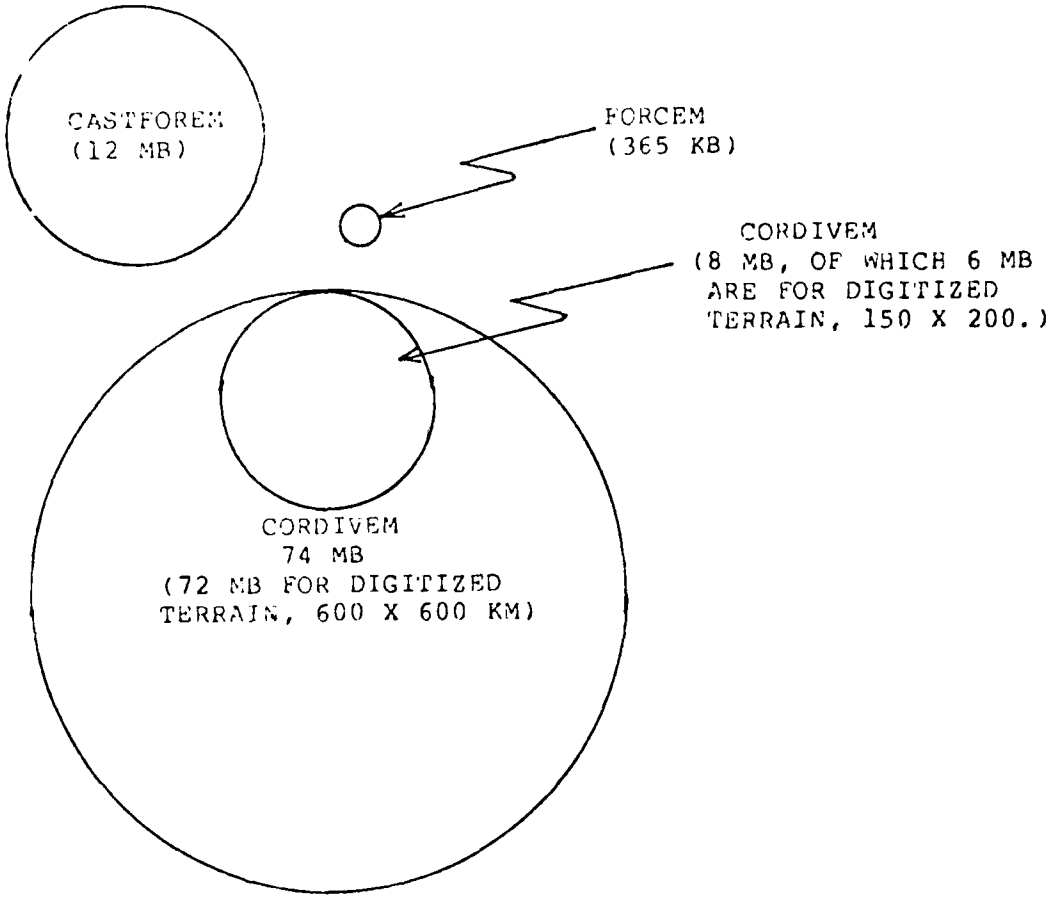



Figure 2-1 Comparative Size of AMIP Data Bases

that the volume of AMIP data is not a serious consideration for selection of a DBMS. Any of the considered DBMSs could accommodate the total data base of any of the AMIP models, or of all their combined data, with adequate capability remaining to accomodate AMIP model expansion or addition of other model data bases to the AMIP program.

*Assuming all limits can be approached independently. A safer estimate would be $3.2 \times 10^9$, still well above AMIP requirements.

## 2.2 Force Description Representation

### 2.2.1 General

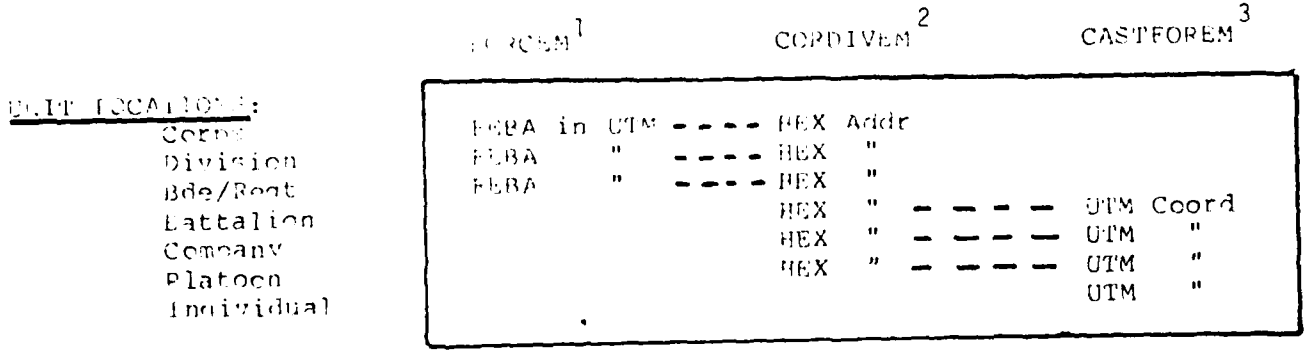
Each of the three models represents the Red and Blue forces in its own unique way Although some "candidates" for commonality were identified, no common data items will exist among the models under the current plans for development.

### 2.2.2 Unit Locations

The method of accounting for unit locations differs in all the models (see Figure 2-2), but all use the UTM coordinate system. CASTFOREM uses UTM to identify the unit's Command Post location (a point), while FORCEM uses UTM to identify the portion of the FEBA occupied by the unit (a line). CORDIVEM uses UTM to develop its HEX address system. Opportunities for duplicating data in more than one model occur at battalion, company and platoon levels for CORDIVEM and CASTFOREM, and at corps, division and brigade levels for FORCEM and CORDIVEM, as shown in the figure. No candidate exists for three-way overlap.

### 2.2.3 Unit Designations

The AMIP models have three separate schemes for unit designation (Figure 2-3). FORCEM uses an eight character unformatted TEXT variable for designating corps, divisions and brigades (e.g.; 2 ARM). CORDIVEM uses an




NOTES

1. FORCEM uses a variable grid composed of a maximum of 100 bands and a maximum of 1000 sectors per scenario being gamed.

2. The COPDIVEM HEX system is a product of a UTM transformation process which allows for 13 scale changes. The areas covered range from 4600 square meters (level 9), to a maximum of 63679389 square kilometers (level 12). The selected HEX scale is level 4, or 3.57 kilometer diameter (geometric center to geometric center).

3. The CASTFOREM grid system accomodates two reference scales, 25 or 12.5 meter squares (625 or 156.25 square meters respectively).

Figure 2-2. Force Description: Unit Locations.

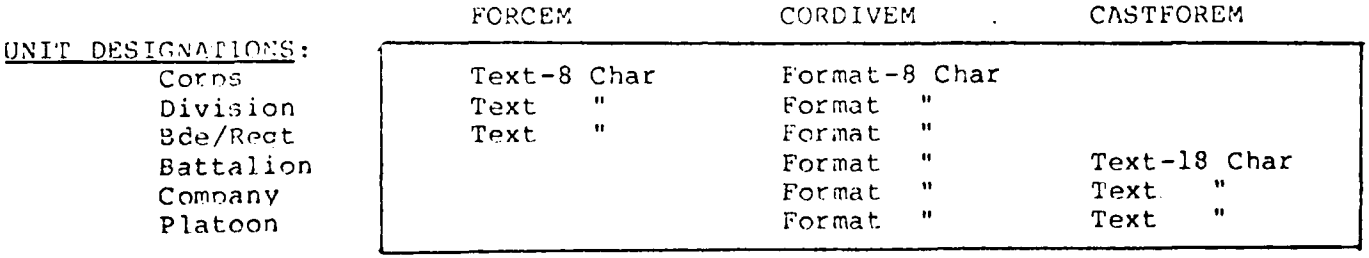



Figure 2-3 AMIP Force Description: Unit Designations

eight character FORMATTED numbering system (e.g.; SDDRRBBB). CASTFOREM uses 18 unformatted text characters to designate its units. As Figure 2-3 indicates, no three-way overlap exists in unit designations, but all unit levels could be duplicated in two models. Brigade through corps are common to FORCEM and CORDIVEM and platoon through battalion are common for CASTFOREM and CORDIVEM. Through reformatting of the unit designations, it may be possible for a common link to be established from CASTFOREM to CORDIVEM, and from CORDIVEM to FORCEM ... establishing a foundation for passage of force description, performance or characteristics information from model to model, should that be desired.

### 2.2.4 Force Structure and Composition

All three AMIP models will account for force composition and structure by identifying subordinate units (shown as "ID Sub" in Figure 2-4) assigned to each headquarters. CORDIVEM and CASTFOREM also account for superior (or owner) of each unit. CORDIVEM also identifies the type of unit from

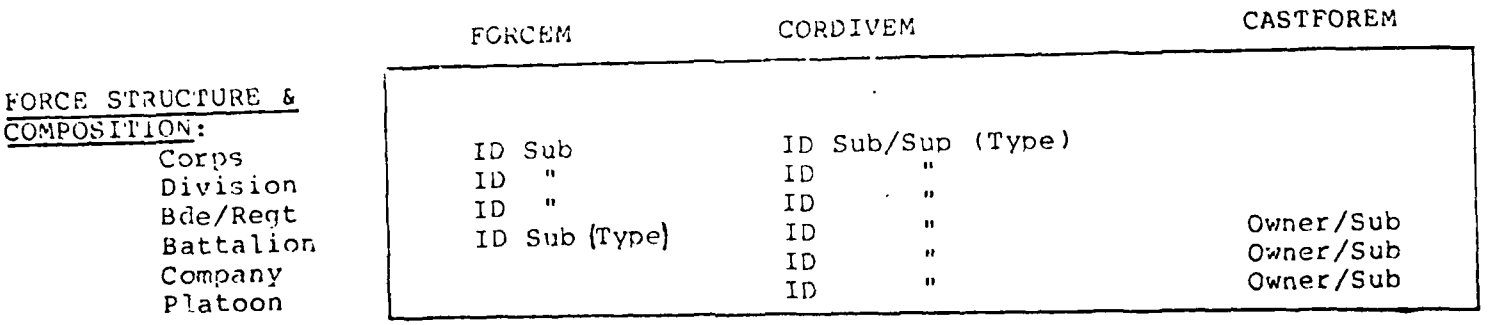
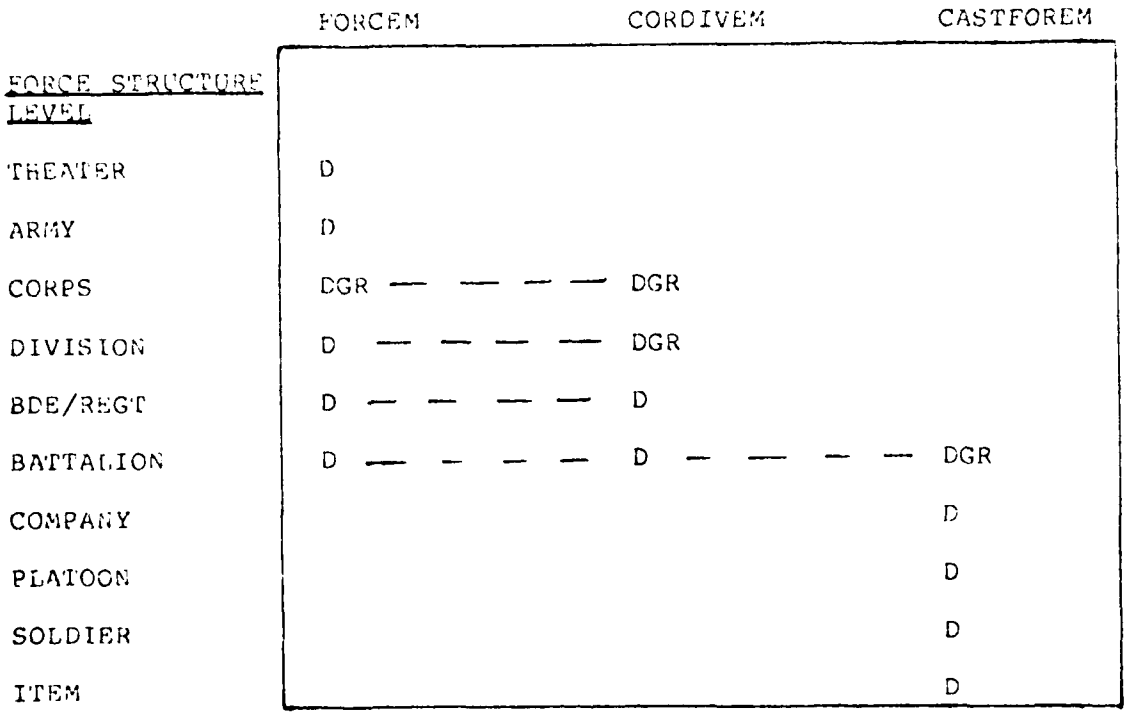





Figure 2-4 AMIP Force Description: Force Structure & Composition




KEY: D=Data Base Required.
G=Level of "Game"
R=Level of Aggregation

Figure 2-5 Force Description: Force Structure Level

| UNIT/SYSTEM TYPES: | FORCEM | CORDIVEM | CASTFOREM |
|---|---|---|---|
| Maneuver Battalion | 18 | 5 | Unspecified |
| Arty Cannon | 8 | Unspecified | Unspecified |
| Arty Bn Types | 15 | Unspecified | Unspecified |
| Tanks | 12 | Unspecified | Unspecified |
| Helicopters | 5 | Unspecified | Unspecified |
| Aircraft | Unspecified | Recon Plus 18 /side | Unspecified |



Figure 2-6 Force Description: Unit and System Types

most units and systems. CASTFOREM is designed to accomodate as many variations from standard units/systems as the user chooses to identify.

## 2.3 Tactical Aircraft and Air Defense Representation

TACAIR and ground based air defense forces are treated differently in each of the three models. Because of CASTFOREM's small geographical area of consideration, only Close Air Support (CAS) and Short Range Air Defense (SHORAD) forces are gamed, and those only in the vicinity of the evaluated force (e.g.; Battalion Task Force). Figure 2-7 illustrates the process used by CASTFOREM to game SHORAD. CORDIVEM can explicitly or implicitly play air defenses (although it always explicitly plays TACAIR). When explicit, both SHORAD and longer range air defenses (I-HAWK and PATRIOT, for example) are played against the total TACAIR force. Aircraft sortie flight paths are represented from the airfield to the target and back (HEX identification), and air defense weapons are gamed against them. FORCEM also assesses the total theater TACAIR force against the total air defense force, but it employs an attrition/service rate approach; reducing the number of aircraft in the force based on the rate of attrition and the duration of exposure to the attrition. Air defense systems are assessed based on tons of ammunition expended per aircraft kill.

While the CASTFOREM data base offers little opportunity either for commonality of data with the other models, or calibration of CAS or air defense for them, there do appear to be opportunities for commonality between CORDIVEM and FORCEM. Generally, both assess the total theater force of US TACAIR and ground based air defenses. Because CORDIVEM games them and FORCEM does not, there might be future opportunities for CORDIVEM to calibrate FORCEM TACAIR and air defense forces with killer/victim scoreboards. Conversely, aircraft and air defense logistics and maintenance results obtained in FORCEM may be of value in calibrating the availability of these assets in CORDIVEM.

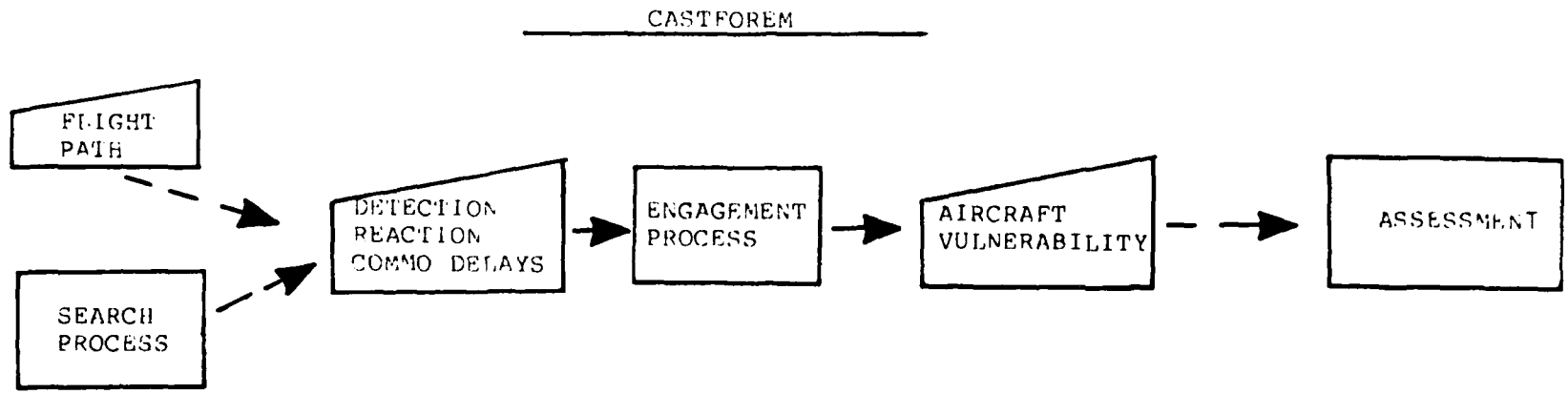



Figure 2-7. CASTFOREM Air Defense Assessment Process.

## 2.4 Non-US Blue Forces Representation

One dimension that should be discussed is the representation of allies in the AMIP models. CASTFOREM does not normally include allies in its data base because it exists principally to game US Battalion Task Force equipment, doctrine and tactics (although it could game allied forces if required). Because, like CASTFOREM, CORDIVEM will be oriented toward assessing US division and corps doctrinal considerations, it will probably not maintain a data base consisting of non-US Blue Forces. FORCEM, on the other hand, will maintain an extensive base of allied forces data. This difference in FORCEM and CORDIVEM/CASTFOREM data requirements does not appear to be a potential obstacle to centralizing a data base, and, in fact, could offer opportunities for CORDIVEM assessments. If a common data base existed which could facilitate feeding an allied force data base into a CORDIVEM model, the US forces performance could be assessed in a broader theater-wide context. (For example, assessment of a V Corps response to a large scale penetration in a non-US corps on its flank).

## 2.5 Doctrinal vs. Fiscally Constrained Forces

TRASANA and CASAA, being agencies within TRADOC, are principally interested in providing assessments of doctrinal forces and their optimal employment (Division 86 forces, for example). CAA, on the other hand, will probably have a different force in its data base ... a force that is fiscally constrained within the Five Year Force Development Plan (FYDP) projections. The data base representing the 1986 division gamed by FORCEM in support of the DA, DCSOPS Staff may bear little resemblance to the 1986 division gamed by CORDIVEM or the battalion task force gamed by CASTFOREM in support of TRADOC.

The passage of performance results such as Killer/Victim Scoreboards from CORDIVEM, a model normally used with doctrinal forces, may not adequately represent a fiscally constrained force unless a constrained data base is used. Calibration from one model to another should, therefore, take this data base difference into account.

## 2.6 Performance Representation

All three models use input performance data from AMSAA to determine weapon system capabilities. Beyond that, however, the data representation of performance data in CASTFOREM is quite different from the other two models. Variations in armament composition, muzzle velocity, and aspect angle of the target in relationship to the weapon system are variations from standard data that are treated in CASTFOREM, but not in FORCEM or CORDIVEM (see Figure 2-8). The latter two models essentially limit their data base to basic data such as kill probabilities and average ranges to the targets. Analysis has shown considerable difference in CASTFOREM resolution in this area and the resolution in the other two models as illustrated in Figure 2-9. Accordingly, pursuit of a scheme for calibrating the weapon system performances in CORDIVEM and FORCEM with CASTFOREM would appear to be desirable. The only performance interface among the AMIP models that is currently operational is from CASTFOREM to CORDIVEM, using an analytic model, COMANEW, to resolve combat interactions in CORDIVEM. CEM V, the current theater level forerunner to FORCEM is calibrated by a stochastic simulation of division level combat, COSAGE.

Killer/Victim scoreboards are not the only performance activities of importance that should be considered for calibration from one AMIP model to another. Candidates include Combat Service Support (maintenance and logistics), TACAIR, Air Defense and others. Figure 2-10 illustrates the interfaces of requirements and results which could exist between the AMIP models.

## 2.7 Environmental Data Representation

The environmental data (terrain and weather) in both CASTFOREM and CORDIVEM models will be used to cause the movement and interactions between the model entities to reasonably approximate the activity of real units over the gaming area, and to the resolution required by the analysis. FORCEM also considers terrain, but not weather. It is planned that if weather influences unit/weapon performance, it will be included in the calibration provided by CORDIVEM to FORCEM. Figures 2-11 and 2-12

KILLER - VICTIM SCOREBOARDS

| SHOOTER DESCRIPTION | FORCE1 | FORCE2 | FORCE3 |
|---|---|---|---|
| Type of Model (V Type) | X | X | X |
| Variations Within Standard | | | X |
| Aspect with Target | | | X |
| Ammunition Types | Two | Two | All |
| Variations Within Standard | | | X |

Figure 2-8. AMIP Representation of Killer - Victim Scoreboards.

| RESULTS | FORCEM REQ | CORDIVEM CAP | CASTFOREM |
|---|---|---|---|
| Search Procedure | | | X |
| Probability Acq, Det, Hit | | | X |
| Delay Times: Det, React, Comme. | | | X |
| Unit FP, MN, FM, & K, Kill | | | X<br>X |
| Vehicle Lt, Mod, Severe, Damage and Destroyed | | | X<br>X |
| Individual Lt, Mod, Severe Wounded and Killed | | | X<br>X |
| Probability of Kill | X | X | |
| Average Range | X | X | |

Figure 2-9 . Killer-Victim Scoreboards.

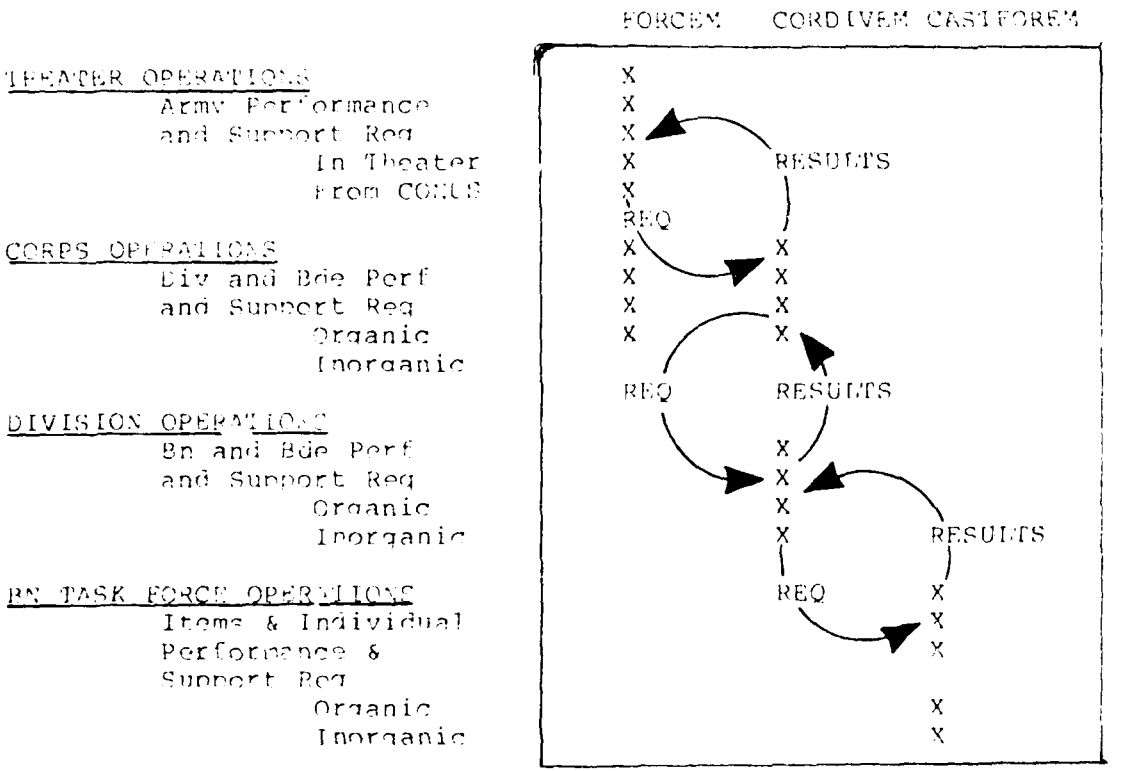



Figure 2-10. AMIP Model Operations, Performance and Support Interfaces.

| TERRAIN DATA | CASTFOREM | CORDIVEM | FORCEM |
|---|---|---|---|
| Roads | E | E | I |
| Primary | E | E | |
| Secondary | E | E | |
| Tertiary | E | E | |
| Hypsography (Phys Terrain) | E | E | E |
| Elev Matrix | E | E | I |
| Spot Elev | E | E | I |
| Slope | E | E | I |
| Vegetation | E | E | E |
| Canopy Ht | E | | |
| Canopy Closure | E | | |
| Tree Type | I | I | |
| Stem Spacing | | E | I |
| Season | E | I | I |
| Areas Populated | E | E | |
| Surface Materials (Soils) | E | | |
| Type | E | | |
| Roughness | | | |
| Wetness | E | | |
| Rated Cone Index | E | | |
| Seasonal Qualifier | E | | |
| Airfields | I | I | I |
| Max Acft Size Accom | I | I | I |
| Hydrology | | | |
| Types | E | E | E |
| Obstacles | E | I | I |
| Heights | E | I | I |

KEY: E=Explicit; I=Implicit

Figure 2-11 AMIP Terrain Data Representation

| CLIMATIC DATA | CASTFOREM | CORDIVEM | FORCEM Note: (3) |
|---|---|---|---|
| Time: | | | |
| Day | EXPL | EXPL | None |
| Year | EXPL | IMPL | None |
| Location (1) | IMPL | IMPL | IMPL |
| Temp: | EXPL | EXPL | IMPL (2) |
| Mo. Mean | IMPL | IMPL | IMPL (2) |
| Humidity | EXPL | IMPL | None |
| Pressure | EXPL | IMPL | None |
| Precipitation | EXPL | EXPL | IMPL (2) |
| Wind: | EXPL | IMPL | None |
| Direction | EXPL | IMPL | None |
| Speed | EXPL | IMPL | None |
| Sky Cond: | EXPL | None | None |
| Cloud (%) | EXPL | None | None |
| Ceiling | EXPL | None | None |
| Sunshine | EXPL | None | None |
| Sun Angle | EXPL | None | None |
| Luminance | EXPL | None | None |
| Visibility | EXPL | EXPL | None |

Note 1. Actual or contrived.
Note 2. Implied as portion of Terrain Type Computation.
Note 3. Climatic Data Requirements not yet defined.

Figure 2-12. AMIP Model Climatic Data.

illustrate the differences in AMIP model requirements for environmental data.

Environmental (or more precisely terrain) data consumes a significant portion of the AMIP model storage capacity as shown in Figure 2-13. The CASTFOREM model's terrain data base covers over 41,000 square KM, and each square KM requires 9600 bytes of data (or 3.84 kilobytes per 20 x 20 KM area used for a battalion task force analysis). For comparison, CORDIVEM's current baseline European terrain data base covers 30,000 square KM and requires 200 bytes of data per square KM. Within the CORDIVEM model, terrain storage constitutes 97 percent of the model's data requirements.

There are a number of data elements common to more than one of the AMIP models but the differences in format mitigate against standardization of the terrain data bases, with the possible exception that CORDIVEM and FORCEM require essentially the same scale of terrain data (e.g., the NATO theater) and the resolution required for CORDIVEM may be of value to FORCEM in assessing convoy movements and other terrain related activities. Since neither CORDIVEM nor FORCEM has been fully developed, consideration should be given to enhancement of commonalities in the terrain representation for these two models.

TERRAIN RESOLUTION

| MODEL | BYTES/KM$^2$ |
|---|---|
| CASTFOREM | 9600 |
| CORDIVEM | 200 |
| FORCEM | 8* |

* Variable. 120 X 200 Square KM area is shown.

Figure 2-13. AMIP Data Base Requirements for Terrain.

## REFERENCES FOR TASK 1


1. US Army CAA, Concepts Evaluation Model V, (CEM V), Part III - Users Handbook (CAA-D-80-3), February, 1980.

2. CAA Memo for DCSOPS, DA, Input Data Requirements for TAA-88 Analysis, February 24, 1981.

3. CAA Memo for DCSOPS, DA, Input Requirements for TAA-88 Army 90 Excursion, 27 October, 1981.

4. US Army TRASANA, CASTFOREM Preamble Printout dated 26 October, 1981.

5. US Army CAA, Projected FORCEM Data Requirements (Tank Related Only) Printout, dated 20 July, 1981.

6. BDM Corporation, ICOR Users Manual (Draft), Vol II, ICOR Model Operation, BDM/W-81-520-TR, October, 1981.

7. US Army TRASANA, Battalion Level Model Resource Meeting, 30 September - 1 October, 1981, Minutes dated 26 October, 1981.

8. US Army CASAA, Printout, Subject; Subroutine Information: Ammunition Resupply Model (ARM), dated 16 December, 1981.

## 3.0 DBMS SURVEY AND EVALUATION

This section presents the results of the Survey and Evaluation of commercially available Data Base Management Systems selected as candidates to provide overall data management of Army models data under the Army Model Improvement Program.

Subsection 3.1 discusses the Survey procedures and presents the results.

Subsection 3.2 discusses the Evaluation methodology and presents results of the Evaluation, including scoring results, rationale, conclusions and recommendations.

### 3.1 DBMS Survey

"General Survey of Data Base Management Systems" has been prepared for the Army Model Management Office under the Army Model Improvement Program contract number DABT58-81-C-0147 as a standalone document.

This survey includes the five products which are considered to be Data Base Management Systems (DBMS) and which can be used on the UNIVAC Series 1100/80, the computer readily available for use in the FORCEM, CORDIVEM and CASTFOREM modeling functions. These candidate DBMSs are BASIS, DMS-1100, RAPPORT, SIBAS, and SYSTEM 2000. The sixth, seventh and eighth candidates are ADABAS-M for PDP-11 and VAX-11 computers, SQL/DS for IBM, and MRDS/Multics for Honeywell computers. The IBM product is scheduled for first delivery during the first quarter of 1982. It is a commercial product based upon the research project "System R". Documentation on SQL/DS is preliminary and subject to change. No user experience will be available for surveying within the near future.

A ninth candidate, a Data Base Machine, the Britton-Lee IDM-500, is being configured to be used with the UNIVAC Series 1100 computers. Many of the survey questions are not meaningful for the data base machine and others are answered based upon the potential of the IDM-500, not on proven or documented capabilities. Within this report the term "DBMS" generally will include all nine candidates without implying that each candidate strictly conforms to the definition of a DBMS.

### 3.1.1 Survey Methodology

The survey presents major categories identifying desired DBMS funtions and general information concerning the implementation of each DBMS. Each major category has been defined in further detail where necessary, in terms of sub-functions and/or components, so that the bulk of the survey could be completed by indicating whether or not each DBMS supports the specific feature. For the most part, this survey does not try to answer subjective or performance related questions such as the "ease of . . ." or the "speed of . . .". It notes simply that the function can be done or cannot be done in the case of unambiguously specified capabilities, or to what degree of completeness or power it has been implemented in other cases. A blank entry indicates that insufficient documentation was available on the subject. Features that required more information have been accompanied by a reference to the Explanatory Notes pages. All information in support of this survey has been obtained from vendor documentation, reports of previous performance evaluations, and other technical literature, as listed by code on the Bibliography pages. The source of information for each category of the survey has been cross-referenced through Source Citations pages the form bibliography-code:page-number. Obviously the accuracy is limited to the accuracy of the source data.

#### 3.1.1.1 Survey Sources

Sources used are of the following kind:

- Vendor documentation currently resident in the Mc2 technical library
- Additional documentation requested from vendors as necessary
- Trade evaluation articles and publications
- Interviews with vendors
- Interviews with users

The survey bibliograpny contains all of the sources which were used.

#### 3.1.1.2 Survey Report Format

The format of the survey is designed not only to give yes/no answers as to the existence of capabilities and characteristics, but to give expanded information where needed and, very important, to record as part of the report the document from which the answers have been derived.

The first section of the survey is a table presenting information for each of the DBMSs surveyed concerning capabilities and characteristics. Where desirable or necessary, the answers in the survey are noted for reference to the Explanatory Notes. This permits expanded notes which are not artificially constrained by space limitations.

The Source Citations portion of the Survey Report has a format which references both the survey item number and the bibliography item number. It is completed by filling in a coded reference number which represents the page and document(s) (or other source) from which the answer in the survey was derived.

The Bibliography portion of the Survey Report lists all sources used during the Survey with accompanying codes for easy reference from the Source Citations.

### 3.1.2 Survey Report

The following pages contain the General DBMS Survey Report. They are arranged in the following structure:

- Survey answers for all DBMSs
- Explanatory Notes for all DBMSs
- For each DBMS
  - Bibliography
  - Source Citations
- User and Vendor Interviews for all DBMSs

| | CHARACTERISTIC | ADABAS-M | BASIS | IDM-500 | DMS 1100 | SQL/DS | RAPPORT | SIBAS | S-2000 | MRDS |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | DESCRIPTION | | | | | | | | | |
| 2 | Name | ADABAS-M | BASIS | IDM-500 | DMS 1100 | SQL/DS Note | RAPPORT | SIBAS | System2000 | MRDS Note |
| 3 | Producer | Software AG | BATTELLE | Britton Lee | UNIVAC | IBM | Logica Inc. | SRS A/S | INTEL Sys. | HONEYWELL |
| 4 | Cost | | | | | Note | | | | |
| 5 | Purchase (Dollars) | 40000 | 104000,Note | 50000,Note | N/A | N/A | $44000 Note | $50000,Note | 108000Note | N/A |
| 6 | Lease (Month) | $1800 Note | | | $1395 Note | $300 | Negotiable | $1300 | $1125 | $1050 |
| 7 | Maintenance (Year) | 44000 Note | | Note | | $1260 | Note | $5000 | $10800 | |
| 8 | Availability | | | | | | | | | |
| 9 | Date Operational | 1979 | 1973 | 1981 | 1971 | 1982 | 1979 | 1972 | 1970 | 1976 Note |
| 10 | Number Installed | Note | >50 | | 500 | Test Sites | Note | 150 | | |
| 10A | Location of Developer | Germany | USA | USA | USA | USA | U.K. | Norway | USA | USA |
| 11 | Documentation | | | | | | | | | |
| 12 | Manuals | Note | Note | Note | Note | Note | Note | Note | Note | Note |
| 13 | Perform./Reliability Stats. | | Note | | | | | | | |
| 14 | Vendor Training | Yes | Yes Note | Yes Note | Available | No Data | Available | Yes | Yes | Yes |
| 14A | Vendor Assistance | Yes Note | Yes Note | Yes Note | Available | No Data | Available | | Note | Yes |
| 14B | Implementation Language | F'TRAN Note | Note | | | | FORTRAN | F'TRAN,ASSM | | PL/1 |
| 15 | RESOURCE REQUIREMENTS | | | | | | | | | |
| 16 | Main Frame | PDP11,VAX | UNIVAC-1100 | IDM-500 | UNIVAC-1100 | IBM Only | UNIVAC-1100 | UNIVAC-1100 | UNIVAC1100 | HONEYWELL 6180/6880 |

| | CHARACTERISTIC | ADABAS-M | BASIS | IDM-500 | DMS 1100 | SQL/DS | RAPPORT | SIBAS | S-2000 | MRDS |
|---|---|---|---|---|---|---|---|---|---|---|
| 17 | Memory | 64K Bytes | | Note | Note | | <<64K words | 23K words | 32K words | |
| 18 | Peripherals | | | Disks | Disk,2Tapes | | | | Note | Disk |
| 19 | Operating System | VAX,IAS,RSX | EXEC 8 | Part of DMS | EXEC 8 | VSE | EXEC 8 | EXEC 8 | EXEC 8 | MRDS |
| 20 | Other Computers | IBM | Note | Note | UNIVAC 90 | None | Note | Note | IBM,CDC | None |
| 21 | CAPACITY | | | | | | | | | Note |
| 22 | Maximum Size of Data Base | 250 Files | Note | Note | Note | | O.S.Limits | No max. | O.S.Limits | No Files Open |
| 23 | Maximum Size of File | 16M records | | Note | | | 1M Records | No max. | O.S.Limits | |
| 24 | Maximum Size of Record | Note | Note | 2000 Bytes | 7280 words | ≥ 32767 | Disk Block | No max. | | |
| 24A | Maximum No. of Files | | | | | | Unlimited | | | |
| 24B | Maximum No. of Record Types | | | 160,000 | | | | | | |
| 25 | LOGICAL DATA MODEL | Note | | | | | | | | |
| 26 | Hierarchical | Note | Note | No | No | No | No | No | Yes32Lev. | No |
| 27 | Network | Note | No | No | CODASYL | No | No | CODASY | NoteNote | No |
| 28 | Relational | Note | No | Yes | No | Yes | Yes | No | Note | Yes |
| 28A | Combinations | Note | Note | No | No | No | No | No | Note | No |
| 29 | Implementation Structure | Index | Index | Index | Note | Index | Hash | Note | Index | Index |

| CHARACTERISTIC | ADABAS-M | BASIS | IDM-500 | DMS 1100 | SQL/DS | RAPPORT | SIBAS | S-2000 | MRDS |
|---|---|---|---|---|---|---|---|---|---|
| 30 DATA DICTIONARY | | | | Note | | Future,Note | | Yes,Note | |
| 31 Host Language | No | No | No | No | No | No | No | No | No |
| 32 Self-Contained | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 33 Schema Capability | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 34 Sub-Schema Capability | Yes | | Yes | Yes | Yes | No | Some Feat. | | Yes Note |
| 34A User Creation of Views | No | No | Yes | No | Yes,Note | No | | No | Yes Note |
| 35 User Query of Dictionary | No | Yes | Yes | No | Yes | No | No | No | No |
| 36 User Update of Dictionary | No | No | Yes | No | Yes | No | No | No | No |
| 37 MODES OF OPERATION | | | | | | | | | |
| 38 Batch | Yes | Yes | Yes | Yes | Yes | Yes | Yes | | Yes |
| 39 On-Line | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 40 LOAD FUNCTION | Note | | | | | | | | |
| 41 Bulk Utility Load | Yes | Yes | No | No | Yes | Yes | No | Yes | Yes Note |
| 42 Foreign File Load | | | | Host Lang'ge | | via FORTRAN | Conv.Utility | Yes | Yes Note |
| 43 UPDATE FUNCTION | | | | | | | | | |
| 44 Host Language Interface | Call | Call | Call | DML | DML | DML | DML | DML | Call |
| 45 Host Language | | | | | | | | | |

| | CHARACTERISTIC | ADABAS-M | BASIS | IDM-500 | DMS 1100 | SQL/DS | RAPPORT | SIBAS | S-2000 | MRI S |
|---|---|---|---|---|---|---|---|---|---|---|
| 46 | FORTRAN | Yes | No,Note | Yes | Yes | No | Yes | Yes (Call) | Yes | Yes |
| 47 | COBOL | Yes | No | Yes | Yes | Yes | Yes | Yes (DMI) | Yes | Yes |
| 48 | PASCAL | Yes | No | Yes | No | No | No | No | No | |
| 49 | PL/1 | Yes | No | Yes | Yes | Yes | No | Yes (Call) | Yes | Yes |
| 50 | C | No | No | Yes | No | No | No | No | No | |
| 51 | ALGOL | No | No | Yes | No | No | No | Yes (Call) | No | |
| 52 | CORAL | No | No | Yes | No | No | Yes | No | No | |
| 53 | Assembly | Yes | No | Yes | No | Yes | No | Yes (Call) | Yes | Yes |
| 54 | Other | No | No | Yes Note | No | No | No | SIMULA | No | No te |
| 55 | Self-Contained | | Yes Note | Implm'table | Yes | | No | Yes,Note | Yes | |
| 56 | Capabilities | | | | | | | | | |
| 57 | Relational Operators | Yes | No | Yes | No | Yes | Yes | No | Yes | Yes |
| 58 | Mathematical Operators | Yes | Limited | Yes | Yes | Yes | No | No | Yes | Yes |
| 59 | Boolean Logic | Yes | No | Yes | No | Yes | Yes Note | No | Yes | Yes |
| 60 | Cartographic Operations | | | | | | Note | Note | | No te |
| 61 | Operations | | | | | | | | | |
| 62 | Modify/Edit | Yes | Batch Only | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 63 | Delete | Yes | Batch Only | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 64 | Add | Yes | Batch Only | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

| | CHARACTERISTIC | ADABAS-M | BASIS | IDM-500 | DMS 1100 | SQL/DS | RAPPORT | SIBAS | S-2000 | MRDS |
|---|---|---|---|---|---|---|---|---|---|---|
| 65 | QUERY FUNCTION | Note | | Implm'table | | | | | | |
| 66 | Host Language | Yes | No | | No | | Yes | | | Yes |
| 76 | Self-Contained | Yes | Yes | Implm'table | Yes QPL | Yes ISQL | Yes IQP | Note | Yes Note | |
| 77 | Capabilities | | | | | | | | | |
| 78 | Relational Operators | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes, Note |
| 79 | Mathematical Operators | | Limited | Yes | Yes | Yes | | No | Yes | Yes |
| 79A | Boolean Logic | Yes | Yes | Yes | Yes | Yes | Note | No | Yes | Yes |
| 79B | Ordered (Sorted Result) | No | No | Yes | No | Yes | Note | No | Yes | No |
| 80 | Cartographic Operations | | | | | | Note | No | | |
| 81 | Data Retrieval Language | | | | | | | | | |
| 82 | Procedural | Yes | No | | Yes | No | No | Yes | No | No |
| 83 | Non-Procedural | No | Yes | Yes | No | Yes | Yes | No | Yes | Yes |
| 84 | Stored Queries & Macros | Yes | Yes | Yes | Yes | Yes | No | No | Yes | No |
| 85 | Builtin Data Summary Funct. | Yes Note | Yes | Yes Note | Yes | Yes | No | No | Yes | Yes, Note |
| 86 | Report Generation | Limited Note | Yes | Implm'table | Yes | Yes | No | No | Yes Note | Yes, Note |
| 86A | Help | Yes | Yes | | | Yes Note | Yes | | | Yes, Note |

| | CHARACTERISTIC | ALABAS-M | BASIS | IIM-500 | DMS 1100 | SQL/DS | RAPPORT | SIRAS | S-2000 | MRDS |
|---|---|---|---|---|---|---|---|---|---|---|
| 87 | ANCILLARY CAPABILITIES | | | | | | | | | |
| 88 | Sort/Merge | | Sort | | No | | Yes | | | Yes, Note |
| 89 | Archive | Yes | Yes(Online) | | Yes | To tape | | | | |
| 90 | Distributed Data Base | | | | | | No | | Yes Note | |
| 90A | Own Code | | | | | | | | Note | |
| 91 | Other Unique Capabilities | Note | Note | | Note | | | Note | | |
| 92 | FILE MANAGEMENT CHARACTERISTICS | | | | | | | | | |
| 93 | General | | | | | | | | | |
| 94 | Physically Sequential | | | | No | | No | | | |
| 95 | Logically Sequential | Yes | Yes | | No | | Yes | Yes | | Yes |
| 96 | Index Sequential | No | | No | Yes | | No | | | Yes |
| 97 | Chained | No | No | No | Yes | No | No | Yes | | No |
| 98 | Inverted | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Partially |
| 99 | Indexing Structures | | | | | | | | | |
| 99A | Kind | B-Tree | B-Tree | B-Tree,Note | Note | ? | Hashed Note | | ? | B-Trees |

| CHARACTERISTIC | | ADABAS-M | PASIS | IDM-500 | DMS 1100 | SQL/DS | RAPPORT | SIBAS | S-2000 | MPDS |
|---|---|---|---|---|---|---|---|---|---|---|
| 100 | Static Organization | No | No | No | No | | Yes | | | |
| 101 | Single-Level | No | No | No | No | | | | | No |
| 102 | Multi-Level | No | No | No | Yes | | | | | No |
| 103 | Dynamic Organization | Yes | Yes | Yes | No | | No | | | Yes |
| 104 | Multi-Field | Yes Note | Yes | Yes | No | Yes | Yes | Yes | Yes | |
| 105 | Multi-Occurrence | Yes | Yes | Yes | No | Yes | Yes | | Yes | |
| 106 | Index Compression | Yes Note | | Note | No | | No | | | |
| 106A | On-line Creation/Deletion | No | | Yes | No | Yes | No | | Yes | |
| 107 | Chain Structures | No | No | No | Yes | No | No | Yes | Note | No |
| 108 | Forward Pointers | No | No | No | Yes | No | No | Yes | | No |
| 109 | Backward Pointers | No | No | No | Yes | No | No | Yes | | No |
| 110 | First and Last Pointers | No | No | No | Yes | No | No | Yes | | No |
| 111 | Parent Pointers | No | No | No | Yes | No | No | Yes | | No |
| 112 | Mixed Chains and Index | No | No | No | Yes | No | No | Yes | | No |
| 113 | Chain Ordering | No | No | No | Yes | No | | | | No |

| | CHARACTERISTIC | ADABAS-M | BASIS | IDM-500 | DMS 1100 | SQL/DS | RAPPORT | SIBAS | S-2000 | M-DS |
|---|---|---|---|---|---|---|---|---|---|---|
| 114 | First | No | No | No | Yes | No | No | | | No |
| 115 | Last | No | No | No | Yes | No | No | | | No |
| 116 | Before | No | No | No | Yes | No | No | | | No |
| 117 | After | No | No | No | Yes | No | No | | | No |
| 118 | Sorted | No | No | No | Yes | No | No | No | | No |
| 119 | Sorted Within Type | No | No | No | Yes,Note | No | No | No | | No |
| 120 | Hash or Calc | No | No | No | Yes | No | Note | Yes | No | No |
| 121 | System Algorithm | No | No | No | Yes | No | Yes | | | No |
| 122 | User Specified Algorithm | No | No | No | Yes | No | Yes | | | No |
| 123 | Allocation | | | | | | | | | |
| 124 | Records | | | | | | | | | |
| 125 | Contiguous | No | | | | | Yes | | | |
| 126 | Block-Contiguous | Yes | | | Yes | | Yes | Yes | | |
| 127 | Non-Contiguous | Yes | | Yes | Yes | | Yes | Yes | | |
| 128 | Storage | | | | | | | | | |
| 129 | Dynamic | Yes | | | Yes | | | | | |

| CHARACTERISTIC | ADABAS-M | BASIS | IDM-500 | DMS 1100 | SQL/DS | RAPPORT | SIBAS | S-2000 | MRDS |
|---|---|---|---|---|---|---|---|---|---|
| 130 Fixed | No | | | | | | | | |
| 130A Tape Capability | | | | | | | | | |
| 131 Multi-Volume Files | Yes Note | | Yes | | | No | No | | |
| 132 File and List Compaction | Yes | | | | | | | | |
| 133 Record Structure | | | | | | | | Hier'chl | |
| 134 Data Compression | Yes | Yes | Yes | | | Yes | | Yes | |
| 135 Variable Length Records | Yes | Yes | Yes | Yes | | No | | Yes | |
| 136 Variable Length Fields | Yes Note | Yes | Yes | No | Yes | | | Yes | |
| 137 Max. Alpha Data Item Size | 128 Bytes | Note | 2000 Bytes | | 32767 | | | 250 | |
| 138 DATA ADMINISTRATION CAPABILITIES | | | | | | | | | |
| 139 File Statistics Report | Yes Note | Yes | No | Yes | Yes | Yes | Yes | Yes | No, Note |
| 140 Number of Records | | | | Yes | | Yes | | Yes | |
| 141 Percentage File Used | | | | | | Yes | | | |
| 142 Percentage Resources Used | Yes Note | | | Yes | | Yes | | Yes | |
| 143 Other | Yes Note | Yes Note | | Yes Note | | | | Note | |
| 144 System Performance Report | Yes Note | No | No | Yes Note | Yes | No | No | Yes | Yes |

| CHARACTERISTIC | ADABAS-M | BASIS | IDM-500 | DMS 1100 | SQL/DS | RAPPORT | SIBAS | S-2000 | MRDS |
|---|---|---|---|---|---|---|---|---|---|
| 145 Re-Organization | | | | | | | | | |
| 146 Physical | Yes | No | No | Yes | Yes | Yes | Yes | Yes | No |
| 147 Logical | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes |
| 148 SYSTEM PROTECTION/CONTROL | | | | | | | | | |
| 149 Program Test Environment | | Yes Note | | Yes Note | | | | | |
| 149A Restart/Recovery | Yes | | Yes | Yes | | Yes | | Yes Note | Yes, Note |
| 150 Audit Log | Yes Note | No | Yes | Yes | Yes | Yes | Yes | Yes | No, Note |
| 151 Disk | Yes | | Yes | | Yes | | | | |
| 152 Tape | No | | | Yes | No | | | | |
| 153 Save/Restore | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No |
| 154 Rollback of Update | No | N/A | Yes | Yes | Yes | Yes | Yes | Yes | No |
| 155 Rollback of Transaction | No | N/A | Yes | in QPL | Yes | Yes | Note | Yes | No |
| 156 Other | | | | | | | | | |
| 157 Concurrency Control/Locking | Note | | | | | | | | |
| 158 Shared Access | Yes | No | Yes | Yes | Yes | Yes | Yes | | Yes, Note |
| 159 Level of Access Sharing | | N/App. | | | | | | | |

| | CHARACTERISTIC | ADABAS-M | BASIS | IDM-500 | DMS 1100 | SQL/DS | RAPPORT | SIBAS | S-2000 | MkDS |
|---|---|---|---|---|---|---|---|---|---|---|
| 160 | Data Base | Yes | Yes | | | | Yes | Yes | | Yes |
| 161 | File/Relation | Yes | | Yes | | | Yes | | Yes | |
| 162 | Set | | | | | | | | | |
| 163 | Record/Tuple | Yes | | | | Yes | Yes | | | Yes |
| 164 | *Attribute/Field/Data Item* | | | | | | Yes | | | |
| 165 | Other | | | | Area | | | Realm | | |
| 166 | Single-User | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 167 | Multi-User | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 168 | Single-Threading | No | No | No | No | | Yes | Yes | No | |
| 169 | Multi-Threading | Yes Note | No | Yes | Yes | | No | No | Yes | No |
| 170 | Deadlock Provisions | Yes | N/A,Note | | Yes | Yes | Yes | Yes Note | | Note |
| 171 | Avoidance | Yes Note | | | | | Lock DB | | | No |
| 172 | Correction | | | | Yes | Yes | Yes | | | No |
| 173 | Security | | | | Yes | | | | | Note |
| 174 | Level of Protection | | | | | | | | | |
| 175 | Data Base | Yes | Password | | Yes | | Yes | Yes | Yes | |
| 176 | File/Relation | Yes | | Yes | | | Yes | | Yes | Yes |

| CHARACTERISTIC | | ADABAS-M | BASIS | IDM-500 | DMS 1100 | SQL/DS | RAPPORT | SIBAS | S-2000 | MRDS |
|---|---|---|---|---|---|---|---|---|---|---|
| 177 | Set | | | | Yes | | Yes | Yes(Realm) | | |
| 178 | Record/Tuple | Yes | Password | | Record Type | | Yes | Yes | Yes | |
| 179 | Attribute/Field/Element | Yes | Password | | | Yes | Yes | | Yes | |
| 180 | Other | | | View | Area | | Note | | | |
| 181 | Permissions | | | Note | Yes | | Note | Note | | |
| 182 | Read | Yes | Yes | Yes | Yes | Yes | Yes,Note | Yes | Yes | Yes |
| 183 | Add | | Yes | | Yes | Yes | Yes | | | Yes |
| 184 | Update | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 185 | Data Encryption | | | | | | Yes | | | |
| 186 | Password Protection | Yes Note | Yes | No | Yes | Yes | Yes | No | Yes | No |
| 187 | Data Integrity/Conversion | | Note | Note | Note | | | | | Note |
| 188 | Encode/Decode | | | | Yes | | Yes | | | No |
| 189 | Range | No | No | No | Yes | No | No | No | No | No |
| 190 | Update Trigger | | | | | | | | | No |
| 191 | Required Element | No | Yes | No | No | Yes | No | No | No | No |
| 192 | Format | Yes | Yes | Yes | Yes | Yes | No | No | No | No |
| 193 | Legal List | No | Yes | No | Yes | No | No | No | No | No |
| 194 | Uniqueness | No | Yes | Yes | Yes | No | Yes | Yes | No | No |

## EXPLANATORY NOTES: ADABAS-M

Software AG of North America, Inc.
11800 Sunrise Valley Drive
Reston, VA 22091
(703) 860 5050 Rex Jaeschke

Line - Comment

6 50% of leasing fee, can be applied to permanent license cost

7 Price per year after first year. First year is included in purchase price.

10 40 on DEC computers, 700 on IBM computers

12
| | |
|---|---|
| ADABAS-M | Introduction |
| ADABAS-M | DBA Reference Manual |
| ADABAS-M | Installation Manual |
| ADABAS-M | Application Programmers Manual |
| ADABAS-M | Training Workbook |

14A Telephone hotline included in maintenance

24 2000 bytes after compression. 255 data items.

25 Software AG calls ADABAS "INVERTED". The structure functions much like a relational structure but is lacking in several features such as on-line creation and deletion of data elements and indexes, searches on non-indexed data elements and joins.

26 See Note 25

27 See Note 25

28 See Note 25

28A See Note 25

40 Initialization utilities requiring approximately 45 minutes must be run before the data base is available for loading.

65 Limited; Tables of results and counts for indexed data elements only.

85 Hit count only. Histogram function available.

86 System Control Utilities manage data base status, run time, and dictionary reporting. May require DBA privileges.

91 Use of phoneticized retrieval reduces errors caused by spelling variations.

104 Up to 32 descriptor fields (keys) per file.

106 Supports backwards compression in addition to normal (removal of blanks) compression.

131 Eight volumes maximum.

136 Supports repeating groups also.

139 DBA (or privileged user) can obtain directory information on each of the data base files.

142 Messages are sent to the DBA indicating "fill percentage" of the log file. Archive must be taken when file is full.

143 Load statistics detail the type and number of disk sectors required after loading partial or complete files.

144 Information can be printed or displayed in report form on thread

statistics and run-time statistics.

150 The system provides asynchronous, multibuffered capture of compressed before-record images and data base update transactions. Logging is to a recycling disk journal, which supports concurrent archiving.

157 Concurrent updates are prevented by a record-level lock that is timed-out to avoid interlock (deadlock).

169 Supports up to 250 threads, up to 8 open files per thread.

171 See Note 157.

186 At the file level.

EXPLANATORY NOTES: BASIS

Battelle Columbus Laboratories
505 King Avenue
Columbus, OH 43201
(614) 424-6424 Steven H. Clark

| Line | Comment | |
|---|---|---|
| 5 | Central System | 38,000 |
| | Forms | 7,000 |
| | Report | 10,000 |
| | Monitor | 5,000 |
| | On-Line Input | 15,000 |
| | Sort | 3,000 |
| | Thesaurus | 8,000 |
| | Profile | 8,000 |
| | Computation | 10,000 |
| | | $104,000 |

12 BASIS Reference Manual
BASIS Data Definition Language Manual
BASIS Utilities Manual
BASIS Programmers' Guide to BASLIB
BASIS Report Manual
BASIS Thesaurus Manual

13 BASIS provides monitoring capability for the data base administrator to compile statistical reports about command frequencies, average frequencies, and summarized statistics on data base retrievals and use.

14 BASIS Training and System Maintenance Training included for two staff members; additional training available.

14A 80 hours included with purchase; additional assistance available.

14B FORTRAN 85%, ASSEMBLY 15% (Source Code included)

20 IBM, CDC, DEC

22 There is a limit: 1,879,000,000 records if records are 30,000 characters. If either of these values need increased it can be accomplished by decreasing the other. These records may be either structured or textual data.

24 See Note 22.

26 The system is described as INVERTED, this probably means a hierarchical data model.

28A See Note 26.

46 FORTRAN calls to BASLIB can be executed in UNIVAC version.

55 Record and index update in batch mode only. On-line requests for modification are placed in a "queue" file until a batch update of the data is executed. The system was developed for users who have large textual data bases which seldom change, but are frequently queried. The developers of BASIS optimized retrieval functions and made the query function easy to use but at a cost of making storage of new information slower and more costly.

91 THESAURUS converts common input name to data element value. For example, AUTOMOBILE is indexed data value and CAR is specified as an alternate for AUTOMOBILE. A query request for CAR will be converted to a request for AUTOMOBILE. Textual storage of data. The SCAN command permits loction of unstructured text containing phrases, words, or groups of words, Sets of words close together can be located such as "RED and BUICK within 5 words of each other".

99A The indexes are restructured at various times by "batch" requests. "Look-ups" between data modification and index restructure require search of both the inverted file and the update queue.

137 See Note 22

143 See Note 13.

149 PROFILE is one of the add-on BASIS options. It saves portions of sessions or an entire session for later re-execution.

170 No Deadlock provision needed because updates are placed on "Queue" file for later data base change.

871 Test of existence of required fields, range checking, others. There are also table lookups, data element cross referencing.

EXPLANATORY NOTES: IDM-500

Britton Lee, Inc
Albright Way
Los Gatos, CA 95030
(408) 378-7000 Mark Willner

The Intelligent Database Machine (IDM), manufactured by Britton Lee Inc., is a data base machine, incorporating Special Purpose Function Architecture (SPFA) devoted to the efficient management of data. The computer contains complete data management system software.

The IDM does not include the interface necessary for movement of requests from the host to the IDM or from the IDM to the host. This software must be obtained in addition to the IDM by OEM dealers or in-house development. At the present time two UNIVAC/IDM general interfaces are being developed by Amperif and Interscience. Writing the interface between the existing AMIP system and the existing IDM DBMS, would require the following steps:

- Communicate with end-user programs
- Translate user commands to IDM-internal form
- Send commands to the IDM
- Receive results from the IDM
- Format the results and transmit to the end-user program

Because there is an OEM interface level between the IDM-500 and the AMIP computer answers to many of the questions in this survey have not been finalized. OEM dealers might not implement software interface to all features of the IDM. Therefore, "yes" answers to many questions in the survey are based upon full use of the capabilties of the IDM-500.

Other OEMs have developed (or are developing IDM interfaces to IBM 370, 30XX, 43XX, and Series 1 computers along with Datapoint, VAX, and Z80 and possibly other computers.

| Line | Comment |
|---|---|
| 5 | $50,000 for the minimum machine. The Database Accelator option is $10,000. This is a likely recommended option, but as of this date it has not become available. With all options the IDM costs about $200,000. Software for the host computer is not included in the above prices. |
| 7 | 90 day warranty (limited). |
| 12 | Software Reference Manual<br>OEM dealers supply additional manuals. |
| 14 | Training classes for 2 persons included if IDM purchased directly from Britton-Lee. If obtained from OEM then training based upon policies of OEM dealer. |
| 14a | Based upon policies of OEM dealer. |
| 20 | Any computer which supports an RS-232, GPIB or IEEE-488 interface |
| 22 | The IDM will manage 50 data bases. Each data base can have up to 32,000 relations (files). There may be up to 2 billion tuples (data items) per relation. |
| 23 | See Note 22 |
| 54 | Not supplied by Britton Lee, OEM vendors have additional interfaces. Can be invoked via any language which contains a standard CALL statement. |
| 55 | Britton Lee developed language IDL which is similar to the INGRES QUEL. The machine is normally sold by OEM vendors who may supply IDL or some other language interface made special for the application. (Two vendors are adding these interfaces for IDM-500/UNIVAC linkups. |

85 Count, average, min, max, sum, existence

106 When possible, the system blocks tuples based upon the clustered (or primary) index.

181 Access can be limited to stored queries.

187 Has a delete duplicate silently "(<?!>) option as well as enforcing uniqueness.
Relations have creation date and obsolete data checks.

EXPLANATORY NOTES: DMS-1100

Sperry UNIVAC
8008 Westpark Drive
McLean, VA 22102
(703) 556-5304 J. Winston Copeland
(215) 542-3278 Jerry Bill

Line Comment

6

| | |
|---|---|
| CMS | $425 |
| QPL 1100 | 365 |
| DD | 365 |
| RPL 1100 | 240 |
| | $1395 |

12 DMS1100 Schema Definition
DMS1100 Sub-schema Definition
DMS1100 COBOL Data Manipulation Language
DMS1100 FORTRAN Data Manipulation Language
DMS1100 PL/1 Data Manipulation Language
DMS1100 Data Management Systems; System Support Functions
DMS1100 Data Management Systems; Operator Reference
DMS1100 Data Management Systems; Summary

17 The amount of memory is dependent upon the overlay description. A 15K structure is minimal, but many users find that 40K structures lead to optimal performance.

22 A data base may contain 68 billion records.

29 DMS-1100 is a pointer based system, but it contains an index sequential feature.

30 DMS-1100 orivudes via the Data Dictionary System a means of centralized description, location and control of the various

elements within a user data base environment. The DDS provides the user with facilities which can be used to describe data so that its representation and its intended use in the real world is clear. It provides a means to describe the relationship between data users and the data base by:

- o Providing a storage place for the actual meaning of the various data elements as well as a description of their physical characteristics and storage layout.

- o Describing the interaction between data and the data base processors, in order to provide information for performance tuning.

- o Providing data base design aids through impact reports on proposed changes.

- o Generating various reports describing the data and their locations in the data base environment or in conventional files.

91 The Remote Processing System RPS 1100 is an End User Facility which provides a screen-image oriented interface to files maintained within the data base. RPS 1100 allows the end user to view a file, manipulate the screen image of the file, and update the file.

99A Though not specified in the CODASYL Report, the location mode of index sequential has been included by Sperry Univac at the request of the users.

119 Called "Within Record Name".

143 The following file statistics can be printed:

Total number of page references (i.e., counter incremented for each page referenced during DMR search)



70

Total number of pages altered
Total number of page I/Os (i.e., page reads)
Total number of overlay I/Os (printed only for segmented DMR)

144 The following performance statistics can be printed:
Total number of times queued and the time spent in the queue (in milliseconds) for various reasons.
Start time/date
Ending time
Total number of imparts
Total number of departs
Total number of main-to-overlay references
Total number of overlay-to-overlay references

149 Multiple data base permits processing in test mode.

187 Existence of required fields.



71

## EXPLANATORY NOTES: SQL/DS

International Business Machines Corporation
Data Procesing Division
1133 Westchester Avenue
White Plains, NY 10604
(914) 696-1900 Mike Bushal

Line Comment

2 Structured Query Language/Data System (SQL/DS) is scheduled to become available during 1982. It is based upon a development effort called "System R". The System R research has been completed.
SQL/DS has previously been called by several other names in addition to System R: SEQUEL; SQL; SQL II

4 A basic license fee costs $300 per month plus a monthly licensed program support charge of $105.

12 Currently available is: IBM Program Product SQL/Data System Concepts and Facilities.

Additional manual should become available near the system release date.

17 The system nucleus with CICS and CSAM needs 1,100K bytes plus 160K bytes for each user. If no overlays 2 megabytes are used. IBM recommends a minimum of 2 megabytes of memory for effective use of SQL/DS

34A The user can update his view of the data base model.

86A The user can see the on-line reference information by using the HELP command and specifying the topic of interest.

EXPLANATORY NOTES: RAPPORT

Logica Inc.
341 Madison Avenue
New York, NY 10017
(212) 599-0828 Richard Gostanian

Line Comment

5 License rather than purchase. Unbundled parts are:

| | |
|---|---|
| Nucleus with preprocessor for FORTRAN or COBOL - | $12,000 |
| Second preprocessor | 6,000 |
| Interactive Query Language | 6,000 |
| Backup and Recovery | 6,000 |
| Multi-User Concurrency Control | 8,000 |
| Data Security Package | 6,000 |
| | $44,000 |

7 7% of license fee after first year.

10 80 world wide, 1 in USA, 3 are UNIVAC.

12 RAPPORT User Manual
Interactive Query Language Manual
Designing and Using a Database
RAPPORT COBOL User Manual

20 VAX-11, PDP-11, ICL 1900, ICL 2900, IBM 370, GEC 4000, Data General NOVA and ECLIPSE, Honeywell 66/60, Harris, Burroughs B6700, and SEL. Logica will install RAPPORT on virtually any machine as part of the normal license price.

30 Some features at current time; complete Data Dictionary will be implemented in the near future.

59 The OR operator will be implemented soon.

60 RAPPORT does not directly support cartographic operations, but the first use was in "war games simulation" for the British Ministry of Defence.

79A AND and NOT currently; OR will be added shortly.

79B Results cannot be found in sorted order or by partial sort (i.e., name = SMI***). Results found by other criteria can be set in temporary storage then sorted and returned to the requestor in sorted order.

80 See Note 60.

99A System uses Hash techniques to store and locate index entries and data, but user view is relational.

120 See Note 99A.

180 Intersection of Fields and Records.

181 via PASSWORDS

182 If read access is not available to some field then its value is replaced with default value. No error message is given. Incorrect results possible when default is used in later calculations.

EXPLANATORY NOTES: SIBAS

Shipping Research Services A/S
2600 Capital National Bank Plaza
333 Clay Street
Houston, TX 77002
(716) 658-8823 Johannes Omvik

| Line | Comment |
|---|---|
| 5 | $25,000 for non-profit organization. |
| 12 | User Manual, DBA Manual, Installation Guide |
| 20 | IBM, DEC-10, CDC, ND-10, PRIME |
| 27 | Developers did not follow CODASYL specification where they felt the CODASYL did not contribute to the most useful DBMS. The system includes the CODASYL-78 addition of involuted sets. |
| 29 | SIBAS is a pointer based system, but it contains an indexed feature. |
| 44 | A Data Manipulation language exists for COBOL. Other host languages require CALLs. |
| 55 | Limited; There is an interactive query-update language, SIBINTER. It encompasses only the calls to the host language SIBAS manipulation modules in a dialogue form more convenient to the user |
| 60 | SIBAS has been used in map digitizing applications. |
| 76 | See Note 55. |
| 91 | Involuted sets. This permits set members to be the same record type as the set owner. |

The REMEMBER verb enables the user to build a log table of desirable records for later use.

155 Updates are made to log file, then a "finish" command causes the transaction to be automatically copied to the data base.

170 Prevention of deadlocks by means of the "keep list" (CODASYL commands:COMMIT/ROLL-BACK;SIBAS commands:LOCK/UNLOCK)

181 Privacy locks on items in record.

EXPLANATORY NOTES: SYSTEM 2000

INTEL Corporation
1620 Elton Road
Silver Springs, MD 20903
(301) 431-1200, Jim Landerkin

| Line | Comment |
|---|---|
| 5 | 1981 price $108,000 for a "typical" system<br>1982 price not expected to differ greatly |
| 12 | DEFINE<br>ACCESS and QUEUE<br>PLEX Users Guide<br>Messages and Codes<br>System Support Manual<br>Report Writers Guide<br>Syntax Guide |
| 14A | A customer hotline service is provided and, in addition, each customer is assigned to a Customer Service Representative (CSR) who provides personalized customer service and a focal point for all communications. The CSR becomes acquainted with the customer's particular environment, ensuring that all support efforts are in line with the customer's specific support needs. |
| 18 | Any hardware which supports EXEC 8. |
| 27 | Hierarchical, but can be viewed as network. |
| 28 | Hierarchical, but can be viewed as relational. |
| 28A | See Notes 27 and 28. |
| 30 | The Data Dictionary exists in the nucleus. |

70 Both QUEST, a normal query language and QUEX, a version of Query by Example.

86 99 reports can be obtained with single pass of portion of data base.

90 One copy of System 2000 needed in network.

90A Exits exist to permit user developed controls to be part of SYSTEM 2000:

Enhanced or specialized security processing.

Dynamic data value encoding.

Creation of user-specific 'dialects' for the PLEX data manipulation language.

Direct SYSTEM 2000 interface to site-developed software such as editing and encryption routines.

SYSTEM 2000 interface with other software packages such as financial accounting, manufacturing, statistical, or graphics systems.

107 Network relationships can be dynamically established. It is not clear whether chains are used.

143 Report of index/table skewness and internal inconsistencies.

149A Full automatic data base recovery for system or program failure. Data integrity is ensured even if one or more programs fail with concurrent batch and on-line.

## EXPLANATORY NOTES: MRDS

Honeywell Information Systems, Inc.
200 Smith Street
Waltham, MA 02154
(617) 895-3247

Line - Comment

2 Multics Relational Data Store

9 Release date of MDBM (Multics Data Base Manager)

12 DBA Guide, MRDS Reference Manual, LINUS Reference Manual, MRPG Reference Guide

21 Supports up to 64 data bases

34 A data submodel may be created at any time by either a user or the DBA, where the data submodel must be a subset and/or a renaming of an existing data base. When a data submodel defines a relation as being a subset of the actual relation in the data base, two restrictions exist:

1 - deleting tuples from such a relation is not permitted when using the submodel.

2 - storing tuples into such a relation is not permitted when using the submodel.

34a No more than 20 temporary relations may exist for one user at a time. The accessing of temporary relations is restricted to retrieve and delete temporary relation operations only.

41 The LINUS store request may be used to load relations from raw text files if the format of the files is identical to the format of the relations.

42 The dsl-$store subroutine is available for writing and executing a load progrm designed to read raw data from existing files and store it into the data base.

54 MRDS is callable from any Multics language supporting a CALL interface (including APL, BASIC, etc.) and is additionally callable from Multics Command level via the MRDS-CALL command.

Line - Comment

61 Retrieve and store operations are the only data base operations that operate on one tuple at a time. A single delete or modify operation on the other hand may potentially delete or modify every tuple in the data base.

78 Set operators are provided which correspond to the commonly defined operators of union, intersection, and difference.

85 Sum, Ave, Count, etc., available through LINUS, other built-in functions include: absolute, after, before, ceiling, concatenate, floor, index, modulus, reverse, round, search, substring, and verify.

86 Through the Level 68/DPS Report Program Generator.

86a A help facility is available for LINUS (logical inquiry and update system).

88 Standard Multics sort commands and subroutines are available for users desiring sorted data.

139 Tools exist to monitor data base usage from various aspects.

149a Using Multics backup retrieval mechanisms, recovery is provided after a system failure or when a disk has been damaged.

150 See note 149a.

158 Data base access is shared unless the data base is opened in an exclusive mode.

170 When opening more than one data base, the openings must be done simultaneously within the same call to MRDS to prevent a deadlock situation. Although a user may repeatedly set and delete scope while the data base is open, the user must delete all scope before setting a new scope to avoid potential deadlock.

173 Standard Multics security features( MULTICS security ranks at or near best).

187 If an incomplete tuple is being stored (i.e., a tuple with one or more unknown attribute values) the user must insert "null" values in the tuple being stored in order to prevent a shifting of attribute values into the wrong attribute field. One rule used in this case is to substitute a blank for fields requiring alphabetic data and a -1 for an attribute requiring numeric data.

# BIBLIOGRAPHIES

# AND

# SOURCE CITATIONS

BIBLIOGRAPHY: ADABAS-M

| Code | Title or Description |
|---|---|
| A1 | ADABAS-M Introduction, Software AG. |
| A2 | ADABAS-M Brochure, Software AG. |
| A3 | "ADABAS-M", DATAPRO RESEARCH CORP., SEPT. 1979. |
| A4 | DBMS Test and Evaluation for the PACOM Data Systems Center, MITRE Corp., 1979 |
| A5 | Classic Fox DBMS Tradeoff Study Report, Appendix F, August 1980. |
| A6 | ADABAS-M Reference Data, Software AG. |
| A7 | Discussion with vendor. |
| A8 | ADASCRIPT-M Reference Manual, Software AG. |
| A9 | ADABAS-M Applicatic Programmer's Manual, Software AG. |
| A10 | ADABAS-M DBA Reference Manual, Software AG. |
| A11 | ADABAS-M Installation Manual, Software AG. |
| A12 | Computerworld, April 6, 1981. |
| A13 | PACOM Data Systems Center Evaluation Report, MITRE Corp., 1979. |
| A14 | "DATAMATION", Sept. 1981, Vol. 27, Number 10. |
| A15 | "ICP INTERFACE" Winter 1981, Vol. 6, Number 4. |
| A16 | Authorized ADP Schedule Price List, Software AG. |



52

SOURCE CITATIONS: ADABAS-M

| ENTRY | REFERENCE | ENTRY | REFERENCE | ENTRY | REFERENCE | ENTRY | REFERENCES |
|---|---|---|---|---|---|---|---|
| 1 | | 44 | A15:95 | 99 | | 146 | A9:99 |
| 2 | | 45 | | 99a | | 147 | |
| 3 | | 46 | A2 | 100 | | 148 | |
| 4 | | 47 | A2 | 101 | | 149 | |
| 5 | A16:22 | 48 | A2 | 102 | | 149a | A2;A3 |
| 6 | A16:22 | 49 | A2 | 103 | A9:99 | 150 | A3;A10 |
| 7 | A16:22 | 50 | | 104 | A15:95 | 151 | A3 |
| 8 | | 51 | | 105 | A1:11 | 152 | A12 |
| 9 | A2,A3 | 52 | | 106 | A2;A3 | 153 | A10:11,21 |
| 10 | A15:95,97 | 53 | A2 | 106a | | 154 | A7 |
| 10a | | 54 | | 107 | A1:29 | 155 | |
| 11 | | 55 | | 108 | A1:29 | 156 | |
| 12 | | 56 | | 109 | A1:29 | 157 | A1:27 |
| 13 | | 57 | | 110 | A1:29A1:29 | 158 | A1:27 |
| 14 | A16:22 | 58 | | 111 | A1:29 | 159 | |
| 14a | | 59 | A8;A9:12 | 112 | A1:29 | 160 | |
| 14b | A2 | 60 | | 113 | A1:29 | 161 | A10:14 |
| 15 | | 61 | A9 | 114 | A1:29 | 162 | |
| 16 | | 62 | A1:19 | 115 | A1:29 | 163 | A1:27 |
| 17 | A3 | 63 | A1:19 | 116 | A1:29 | 164 | |
| 18 | | 64 | A1:19 | 117 | A1:29 | 165 | |
| 19 | A15:95 | 65 | A13:2-8 | 118 | A1:29 | 166 | A15:95 |
| 20 | | 66 | A2;A9 | 119 | | 167 | A15:95 |
| 21 | | 76 | A8 | 120 | | 168 | A15:95 |
| 22 | A13:I-23 | 77 | | 121 | | 169 | A15:95 |
| 23 | A13:I-23 | 78 | A6;A8 | 122 | | 170 | |
| 24 | A1:12;A9 | 79 | | 123 | | 171 | A1:27 |
| 24a | | 79a | A15:95 | 124 | | 172 | |
| 24b | | 79b | | 125 | A1:12;A3 | 173 | |
| 25 | | 80 | | 126 | A1:12;A3 | 174 | |
| 26 | | 81 | | 127 | A1:5,29 | 175 | |
| 27 | | 82 | A9:29 | 128 | | 176 | A13:I-22 |
| 28 | | 83 | | 129 | | 177 | |
| 28a | | 84 | | 130 | | 178 | A1:27 |
| 29 | | 85 | A1:18;A8 | 130a | | 179 | A13:I-22 |
| 30 | | 86 | A1:25;A3 | 131 | | 180 | |
| 31 | | 86a | | 132 | A10:17 | 181 | |
| 32 | | 87 | | 133 | | 182 | A9:27;A10 |
| 33 | A10:5,9 | 88 | | 134 | A9:16 | 183 | |
| 34 | A10:5,9 | 89 | A9:5;A10:6 | 135 | A9:16 | 184 | A9:27;A10 |
| 34a | | 90 | | 136 | A3;A5 | 185 | |
| 35 | | 90a | | 137 | | 186 | A10:5,23 |
| 36 | | 91 | | 138 | | 187 | |
| 37 | | 92 | | 139 | A9:5 | 188 | |
| 38 | A3 | 93 | | 140 | | 189 | |
| 39 | A3 | 94 | | 141 | | 190 | |
| 40 | | 95 | A1:8,12 | 142 | A10:17 | 191 | |
| 41 | | 96 | | 143 | A10:6,27 | 192 | |
| 42 | | 97 | A1:29,A3 | 144 | | 193 | |
| 43 | | 98 | A9:18,A10 | 145 | | 194 | |

## BIBLIOGRAPHY: BASIS

| Code | Title or Description |
|---|---|
| B1 | DATAPRO Reports "BASIS", Oct. 1980. |
| B2 | Auerbach Publishers "BASIS". |
| B3 | What is BASIS. |
| B4 | BASIS-Battelle's Data Management System "Executive Summary" |
| B5 | BASIS Installation Support. |
| B6 | ICP Interface "BASIS", Winter 1981. |
| B7 | Discussion with Vendor. |

SOURCE CITATIONS: BASIS

| ENTRY | REFERENCE | ENTRY | REFERENCE | ENTRY | REFERENCE | ENTRY | REFERENCE |
|---|---|---|---|---|---|---|---|
| 1 | | 44 | | 99 | | 146 | |
| 2 | | 45 | | 99a | B7 | 147 | |
| 3 | B3 | 46 | B7 | 100 | | 148 | |
| 4 | | 47 | B7 | 101 | | 149 | B1:b |
| 5 | | 48 | | 102 | | 149a | |
| 6 | | 49 | | 103 | | 150 | B2 |
| 7 | | 50 | | 104 | B3 | 151 | |
| 8 | | 51 | | 105 | B3 | 152 | |
| 9 | B4 | 52 | | 106 | | 153 | |
| 10 | B4 | 53 | | 106a | | 154 | B2 |
| 10a | | 54 | B7 | 107 | | 155 | B2 |
| 11 | | 55 | B2 | 108 | | 156 | |
| 12 | B3 | 56 | | 109 | | 157 | |
| 13 | B3 | 57 | B3 | 110 | | 158 | |
| 14 | B5 | 58 | B6:87 | 111 | | 159 | |
| 14a | B5 | 59 | B3 | 112 | | 160 | |
| 14b | B3 | 60 | | 113 | | 161 | |
| 15 | | 61 | | 114 | | 162 | |
| 16 | B3 | 62 | B3 | 115 | | 163 | |
| 17 | | 63 | B3 | 116 | | 164 | |
| 18 | | 64 | B3 | 117 | | 165 | |
| 19 | B3 | 65 | | 118 | | 166 | |
| 20 | B1 | 66 | | 119 | | 167 | B7 |
| 21 | | 76 | B3 | 120 | | 168 | |
| 22 | B7 | 77 | | 121 | | 169 | |
| 23 | | 78 | | 122 | | 170 | |
| 24 | B7 | 79 | B6:87 | 123 | | 171 | |
| 24a | | 79a | B3 | 124 | | 172 | |
| 24b | | 79b | B3 | 125 | | 173 | |
| 25 | | 80 | | 126 | | 174 | |
| 26 | B3 | 81 | | 127 | | 175 | B1:1 |
| 27 | B3 | 82 | B3 | 128 | | 176 | |
| 28 | B3 | 83 | B3 | 129 | | 177 | |
| 28a | B3 | 84 | B2 | 130 | | 178 | B1:1 |
| 29 | B3 | 85 | B3 | 130a | | 179 | B1:1 |
| 30 | | 86 | B3 | 131 | | 180 | |
| 31 | B3 | 86a | B4 | 132 | | 181 | |
| 32 | B3 | 87 | | 133 | | 182 | B4:3 |
| 33 | | 88 | B3 | 134 | B7 | 183 | B4:3 |
| 34 | | 89 | B3 | 135 | B7 | 184 | B4:3 |
| 34a | | 90 | | 136 | B7 | 185 | |
| 35 | | 90a | | 137 | | 186 | |
| 36 | | 91 | B3;B6:87 | 138 | | 187 | |
| 37 | | 92 | | 139 | | 188 | |
| 38 | B3 | 93 | | 140 | B1:d | 189 | B4:3 |
| 39 | B3 | 94 | | 141 | | 190 | |
| 40 | | 95 | B1 | 142 | | 191 | B4:3 |
| 41 | | 96 | B7 | 143 | B3 | 192 | |
| 42 | | 97 | | 144 | | 193 | |
| 43 | | 98 | B1 | 145 | | 194 | |



55

BIBLIOGRAPHY: IDM-500

| Code | Title or Description |
|---|---|
| I1 | Discussion with OEM, Interscience. |
| I2 | Discussion with OEM, AMPERIF |
| I3 | IDM-500 Intelligent Database Machine, Product Description. |
| I4 | IDM-500 Intelligent Database Machine, Software Reference Manual |
| I5 | Design Decisions for the Intelligent Data Base Machine by Robert Epstein and Paula Hawthorn, AFIPS Conference Proceedings, Volume 49. Proceedings National Computer Conference 1980 |
| I6 | Computer World, Jan. 5, 1981, "The Looming Battle Between Data Base Machines and Software Data Base Management Systems" by Vincent C. Rawzino. |
| I7 | Discussion with Vendor. |

SOURCE CITATIONS: IDM-500

| ENTRY | REFERENCE | ENTRY | REFERENCE | ENTRY | REFERENCE | ENTRY | REFERENCE |
|---|---|---|---|---|---|---|---|
| 1 | | 44 | | 99 | | 146 | |
| 2 | | 45 | | 99a | I4:1-7 | 147 | |
| 3 | | 46 | | 100 | | 148 | |
| 4 | | 47 | | 101 | | 149 | I4:7-71 |
| 5 | | 48 | | 102 | | 149a | |
| 6 | | 49 | | 103 | | 150 | |
| 7 | | 50 | | 104 | | 151 | I3:16 |
| 8 | | 51 | | 105 | | 152 | |
| 9 | | 52 | | 106 | | 153 | I4:7-53 |
| 10 | | 53 | | 106a | I3:14 | 154 | I3:15 |
| 10a | | 54 | | 107 | | 155 | I4:7-24 |
| 11 | | 55 | | 108 | | 156 | |
| 12 | | 56 | | 109 | | 157 | |
| 13 | | 57 | I4:4-1 | 110 | | 158 | |
| 14 | | 58 | I4:4-1 | 111 | | 159 | |
| 14a | | 59 | I3:12 | 112 | | 160 | |
| 14b | | 60 | | 113 | | 161 | |
| 15 | | 61 | I3:14 | 114 | | 162 | |
| 16 | | 62 | I3:14 | 115 | | 163 | |
| 17 | | 63 | I3:14 | 116 | | 164 | |
| 18 | | 64 | | 117 | | 165 | |
| 19 | | 65 | | 118 | | 166 | |
| 20 | | 66 | | 119 | | 167 | |
| 21 | | 76 | | 120 | | 168 | I5 |
| 22 | I3:3 | 77 | | 121 | | 169 | I5 |
| 23 | I3:3 | 78 | | 122 | | 170 | I5 |
| 24 | I3:3 | 79 | I3:12 | 123 | | 171 | I5 |
| 24a | | 79a | | 124 | | 172 | |
| 24b | I3:3 | 79b | I3:13 | 125 | | 173 | |
| 25 | | 80 | | 126 | | 174 | |
| 26 | | 81 | | 127 | | 175 | |
| 27 | | 82 | | 128 | | 176 | I4A-4 |
| 28 | I3:3 | 83 | I3:12 | 129 | | 177 | |
| 28a | | 84 | I4:3-1 | 130 | | 178 | |
| 29 | | 85 | I3:12 | 130a | | 179 | |
| 30 | | 86 | | 131 | I4:3-10 | 180 | I4A-4 |
| 31 | | 86a | | 132 | | 181 | |
| 32 | | 87 | | 133 | | 182 | I4:7-75 |
| 33 | | 88 | | 134 | I4:A-3 | 183 | I4:7-75 |
| 34 | | 89 | | 135 | I4:A-2 | 184 | I4:7-75 |
| 34a | I4:7-40 | 90 | | 136 | I4:A-3 | 185 | |
| 35 | | 90a | | 137 | | 186 | |
| 36 | I4:A-1 | 91 | | 138 | | 187 | |
| 37 | | 92 | | 139 | | 188 | |
| 38 | | 93 | | 140 | | 189 | |
| 39 | | 94 | | 141 | | 190 | |
| 40 | | 95 | | 142 | | 191 | I4:A-3 |
| 41 | | 96 | | 143 | | 192 | I4:A-2 |
| 42 | | 97 | | 144 | | 193 | I4:A-3 |
| 43 | | 98 | | 145 | | 194 | I4:A-3 |

BIBLIOGRAPHY: DMS-1100

| Code | Title or Description |
|---|---|
| D1 | DATAPRO Reports, DMS 1100. April 1981 |
| D2 | Auerbach Publishers, DMS 1100. |
| D3 | Sperry UNIVAC Series 1100 Schema Definition |
| D4 | Sperry UNIVAC Series 1100 Support Functions |
| D5 | Sperry UNIVAC Series 1100 Support COBOL DML |
| D6 | Sperry UNIVAC Series 1100 Program Product Specification DMS 1100 |
| D7 | Discussion with Vendor |
| D8 | Sperry UNIVAC 1100 Series Data Management System DMS 1100 Software Abstract |
| D9 | Computer World, June 6, 1981 "QPL". |
| D10 | UNIVAC Progam Product Specification Data Dictionay |
| D11 | Sperry UNIVAC Series 1100 Support FORTRAN DML |



SE

SOURCE CITATIONS: DMS-1100

| ENTRY | REFERENCE | ENTRY | REFERENCE | ENTRY | REFERENCE | ENTRY | REFERENCE |
|---|---|---|---|---|---|---|---|
| 1 | | 44 | D6 | 99 | | 146 | D4 |
| 2 | | 45 | | 99a | D8:11 | 147 | D4 |
| 3 | | 46 | D6 | 100 | | 148 | |
| 4 | | 47 | D6 | 101 | | 149 | D7 |
| 5 | | 48 | | 102 | D5:4-12 | 149a | |
| 6 | D1 | 49 | D6 | 103 | | 150 | D5:4-70 |
| 7 | | 50 | | 104 | | 151 | |
| 8 | | 51 | | 105 | | 152 | D4 |
| 9 | D1 | 52 | | 106 | | 153 | D8:46 |
| 10 | D1 | 53 | | 106a | | 154 | D4 |
| 10a | | 54 | | 107 | | 155 | D6 |
| 11 | | 55 | | 108 | | 156 | |
| 12 | D2 | 56 | | 109 | | 157 | |
| 13 | | 57 | D11:3-33 | 110 | | 158 | |
| 14 | D2 | 58 | D8:33 | 111 | | 159 | |
| 14a | | 59 | D11:3-33 | 112 | | 160 | |
| 14b | | 60 | | 113 | | 161 | |
| 15 | | 61 | | 114 | | 162 | |
| 16 | D2 | 62 | D8:18 | 115 | | 163 | |
| 17 | D7 | 63 | D8:18 | 116 | | 164 | |
| 18 | D2 | 64 | D8:17 | 117 | | 165 | |
| 19 | D2 | 65 | | 118 | | 166 | |
| 20 | D2 | 66 | | 119 | | 167 | D8:4 |
| 21 | | 76 | D6:23 | 120 | | 168 | D8:4 |
| 22 | D8:33 | 77 | | 121 | | 169 | D8:4 |
| 23 | | 78 | D11:3-33 | 122 | | 170 | |
| 24 | D8:33 | 79 | D8:33 | 123 | | 171 | |
| 24a | | 79a | D11:3-33 | 124 | | 172 | D4:2-3 |
| 24b | | 79b | | 125 | | 173 | |
| 25 | | 80 | | 126 | | 174 | |
| 26 | D6 | 81 | | 127 | | 175 | D3:3-9 |
| 27 | D6 | 82 | D6 | 128 | | 176 | |
| 28 | D6 | 83 | D6 | 129 | D3:5-1 | 177 | D3:3-70 |
| 28a | D6 | 84 | D8:34 | 130 | | 178 | D3:3-58 |
| 29 | D3:6-2 | 85 | D3:3-66 | 130a | | 179 | |
| 30 | D10 | 86 | D9 | 131 | | 180 | D3:3-30 |
| 31 | D3 | 86a | | 132 | | 181 | D3:3-31 |
| 32 | D3 | 87 | | 133 | | 182 | D3:3-58 |
| 33 | D3 | 88 | | 134 | | 183 | D3:3-58 |
| 34 | D3 | 89 | D8:46 | 135 | | 184 | D3:3-31 |
| 34a | | 90 | | 136 | | 185 | D3:3-31 |
| 35 | D3:J-1 | 90a | | 137 | | 186 | D3:3-58 |
| 36 | D5:1-1 | 91 | | 138 | | 187 | |
| 37 | | 92 | | 139 | D3:J-5 | 188 | D3:3-66 |
| 38 | D6 | 93 | | 140 | D4:7-30 | 189 | D3:3-66 |
| 39 | D6 | 94 | | 141 | | 190 | |
| 40 | | 95 | | 142 | D4:7-11 | 191 | D3:3-88 |
| 41 | | 96 | D2 | 143 | D4:sec 7 | 192 | D3 |
| 42 | D6:17 | 97 | D2 | 144 | D4:sec 7 | 193 | |
| 43 | | 98 | D2 | 145 | | 194 | |



57

BIBLIOGRAPHY: SQL/DL


| Code | Title or Description |
|---|---|
| SQ1 | DATAPRO Software News Volume 7, Number 3, March 1981. |
| SQ2 | IMS Management Feb 9, 1981, "IBM Uncorks First Relational DBMS for 370/4300 Users." |
| SQ3 | IBM Program Product SQL/Data System Concepts and Facilities. |
| SQ4 | Software News Dec 7, 1981, "Practically Speaking Relational DBMS Exist", by Marlene Brown. |
| SQ5 | Information System News August 24, 1981 "Hardware Curbs Relational Systems". |
| SQ6 | Deleted |
| SQ7 | Discussion with vendor. |

SOURCE CITATIONS: SQL/DS

| ENTRY | REFERENCE | ENTRY | REFERENCE | ENTRY | REFERENCE | ENTRY | REFERENCES |
|---|---|---|---|---|---|---|---|
| 1 | | 44 | SQ3:32 | 99 | SQ3:16 | 146 | SQ3:17 |
| 2 | SQ5:12 | 45 | | 99a | | 147 | SQ3:17 |
| 3 | | 46 | | 100 | | 148 | |
| 4 | SQ1 | 47 | SQ3:32 | 101 | | 149 | |
| 5 | SQ1 | 48 | | 102 | | 149a | |
| 6 | SQ1 | 49 | SQ3:32 | 103 | | 150 | |
| 7 | SQ1 | 50 | | 104 | SQ3:16 | 151 | |
| 8 | | 51 | | 105 | SQ3:16 | 152 | |
| 9 | | 52 | | 106 | | 153 | |
| 10 | | 53 | SQ3:32 | 106a | SQ3:16 | 154 | SQ3:51 |
| 10a | | 54 | | 107 | | 155 | SQ3:52 |
| 11 | | 55 | | 108 | | 156 | |
| 12 | | 56 | | 109 | | 157 | |
| 13 | | 57 | SQ3:17 | 110 | | 158 | |
| 14 | | 58 | SQ3:58 | 111 | | 159 | |
| 14a | | 59 | SQ3:58 | 112 | | 160 | |
| 14b | | 60 | | 113 | | 161 | |
| 15 | | 61 | | 114 | | 162 | |
| 16 | SQ3:1 | 62 | SQ3:15 | 115 | | 163 | |
| 17 | SQ7 | 63 | SQ3:15 | 116 | | 164 | |
| 18 | | 64 | SQ3:16 | 117 | | 165 | |
| 19 | SQ3:1 | 65 | | 118 | | 166 | |
| 20 | | 66 | | 119 | | 167 | |
| 21 | | 76 | SQ3:76 | 120 | | 168 | |
| 22 | | 77 | | 121 | | 169 | |
| 23 | | 78 | | 122 | | 170 | |
| 24 | | 79 | SQ3:15 | 123 | | 171 | |
| 24a | | 79a | SQ3:15 | 124 | | 172 | SQ3:54 |
| 24b | | 79b | SQ3:18 | 125 | | 173 | |
| 25 | | 80 | | 126 | | 174 | |
| 26 | | 81 | SQ2:1 | 127 | | 175 | |
| 27 | | 82 | | 128 | | 176 | |
| 28 | SQ4 | 83 | | 129 | | 177 | |
| 28a | | 84 | SQ3:26 | 130 | | 178 | |
| 29 | | 85 | SQ3:14 | 130a | | 179 | SQ3:47 |
| 30 | | 86 | SQ3:22 | 131 | | 180 | |
| 31 | | 86a | SQ3:29 | 132 | | 181 | |
| 32 | SQ3:47 | 87 | | 133 | | 182 | SQ3:46 |
| 33 | | 88 | | 134 | | 183 | SQ3:46 |
| 34 | | 89 | SQ3:61 | 135 | | 184 | SQ3:46 |
| 34a | | 90 | | 136 | SQ3:8 | 185 | |
| 35 | | 90a | | 137 | SQ3:8 | 186 | |
| 36 | | 91 | | 138 | | 187 | |
| 37 | | 92 | | 139 | SQ3:49 | 188 | |
| 38 | SQ3:57 | 93 | | 140 | | 189 | |
| 39 | SQ2:1 | 94 | | 141 | | 190 | |
| 40 | | 95 | | 142 | | 191 | SQ:7 |
| 41 | SQ3:38 | 96 | | 143 | | 192 | SQ3:9 |
| 42 | | 97 | | 144 | SQ3:63 | 193 | |
| 43 | | 98 | | 145 | | 194 | |

BIBLIOGRAPHY: RAPPORT

| Code | Title or Description |
|---|---|
| R1 | DATAPRO Jan. 1981 |
| R2 | Deleted |
| R3 | RAPPORT (product description) |
| R4 | RAPPORT Price List July 1981 |
| R5 | RAPPORT Users Manual |
| R6 | RAPPORT Designing and Using a Database |
| R7 | Discussion with Vendor |
| R8 | Software News Dec 7, 1981, p. 47. "Practically Speaking Relation DBMS Exist" by Marlene Brown |

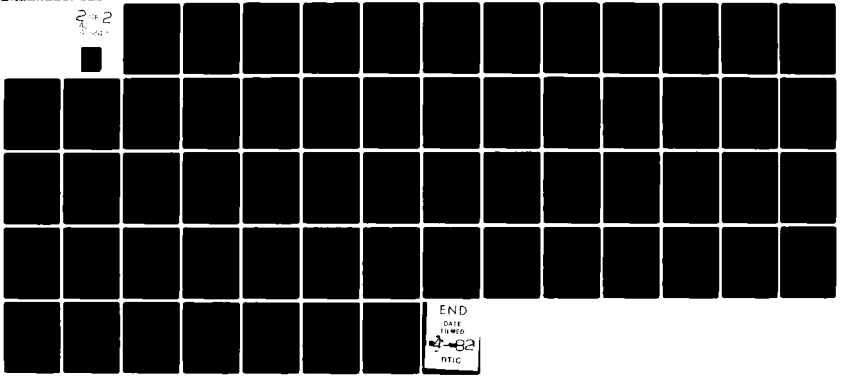
SOURCE CITATIONS: RAPPORT

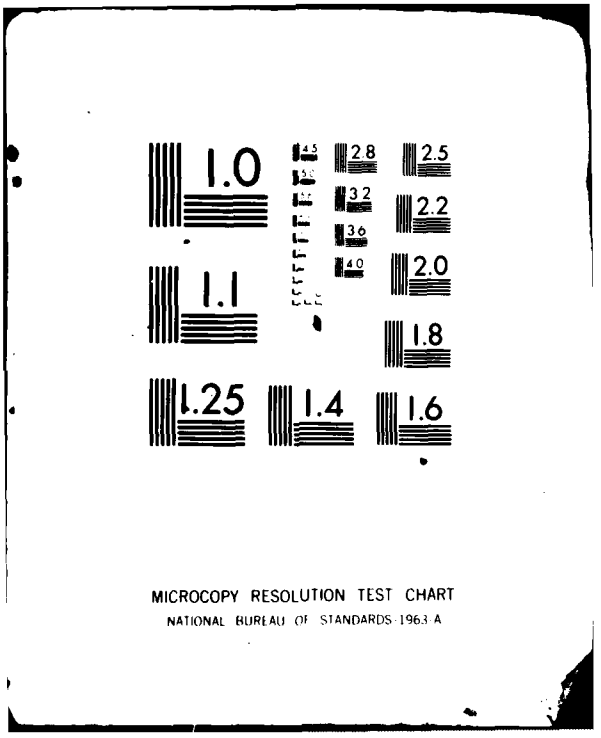
| ENTRY | REFERENCE | ENTRY | REFERENCE | ENTRY | REFERENCE | ENTRY | REFERENCE |
|---|---|---|---|---|---|---|---|
| 1 | | 44 | | 99 | | 146 | |
| 2 | | 45 | | 99a | R5:71 | 147 | R3 |
| 3 | | 46 | R3 | 100 | | 148 | R3 |
| 4 | | 47 | R3 | 101 | | 149 | |
| 5 | R4:1 | 48 | | 102 | | 149a | R5:5-1 |
| 6 | | 49 | | 103 | | 150 | |
| 7 | R4:1 | 50 | | 104 | R6:3-1 | 151 | |
| 8 | | 51 | | 105 | R6:3-3 | 152 | |
| 9 | | 52 | R3 | 106 | | 153 | R5:5-1 |
| 10 | R8:47 | 53 | | 106a | | 154 | R5:1-5 |
| 10a | | 54 | | 107 | | 155 | R5:1-5 |
| 11 | | 55 | | 108 | | 156 | |
| 12 | | 56 | | 109 | | 157 | |
| 13 | | 57 | R3:3-11 | 110 | | 158 | R5:4-1 |
| 14 | | 58 | R3:3-6 | 111 | | 159 | |
| 14a | | 59 | R7 | 112 | | 160 | R5:1-5 |
| 14b | | 60 | | 113 | | 161 | R5:1-5 |
| 15 | | 61 | | 114 | | 162 | |
| 16 | R3 | 62 | R3:3-6 | 115 | | 163 | R5:1-5 |
| 17 | R7 | 63 | R3:3-14 | 116 | | 164 | R5:1-5 |
| 18 | | 64 | | 117 | | 165 | |
| 19 | | 65 | | 118 | | 166 | R7 |
| 20 | R3 | 66 | | 119 | | 167 | R7 |
| 21 | | 76 | | 120 | R6:3-2 | 168 | R7 |
| 22 | | 77 | | 121 | | 169 | R7 |
| 23 | | 78 | R8:47 | 122 | R6:3-8 | 170 | |
| 24 | R6:4-3 | 79 | | 123 | | 171 | R5:4-6 |
| 24a | | 79a | R3 | 124 | | 172 | R5:4-6 |
| 24b | | 79b | R5:2-3 | 125 | | 173 | |
| 25 | | 80 | | 126 | R6:4-2 | 174 | |
| 26 | | 81 | | 127 | R6:4-2 | 175 | R5:6-1 |
| 27 | | 82 | R3 | 128 | | 176 | R5:6-1 |
| 28 | R8:47 | 83 | | 129 | | 177 | R5:6-1 |
| 28a | | 84 | | 130 | | 178 | R5:6-1 |
| 29 | | 85 | | 130a | | 179 | R5:6-1 |
| 30 | | 86 | | 131 | R6:4-2 | 180 | R5:6-1 |
| 31 | | 86a | R7 | 132 | | 181 | |
| 32 | | 87 | | 133 | | 182 | R7 |
| 33 | R7 | 88 | R6:3-10 | 134 | R5:1-3 | 183 | R3 |
| 34 | R7 | 89 | | 135 | 6:2-6 | 184 | |
| 34a | R:1-3 | 90 | | 136 | | 185 | |
| 35 | | 90a | | 137 | | 186 | R5:6-10 |
| 36 | | 91 | | 138 | | 187 | |
| 37 | | 92 | | 139 | | 188 | R3 |
| 38 | | 93 | | 140 | R6 | 189 | R5:6-1 |
| 39 | | 94 | | 141 | R6 | 190 | |
| 40 | | 95 | R5 | 142 | R6 | 191 | |
| 41 | R7 | 96 | | 143 | | 192 | |
| 42 | R7 | 97 | | 144 | | 193 | |
| 43 | R6:5-1 | 98 | R35 | 145 | | 194 | R5:3-5 |

BIBLIOGRAPHY: SIBAS

| Code | Title or Description |
|---|---|
| SI1 | DATAPRO Reports "SIBAS", December 1977 |
| SI2 | SIBAS, The Portable Data Base |
| SI3 | SIBAS, A Portable and Cost Effective CODASYL Database Management System (DBMS) by Mr. Jean-Daniel Gousenberg [from talk given a CDC users meeting]. |
| SI4 | deleted |
| SI5 | Letter from Johannes Ombick of SRS. |
| SI6 | deleted |
| SI7 | Discussion with Vendor. |

AD-A112 471 MEASUREMENT CONCEPT CORP ROME NY F/G 5/2
SURVEY OF DATA BASE MANAGEMENT SYSTEMS.(U)
JAN 82 J HODGES DABT58-81-C-0147
UNCLASSIFIED G81-005 NL




1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

SOURCE CITATIONS: SIBAS

| ENTRY | REFERENCE | ENTRY | REFERENCE | ENTRY | REFERENCE | ENTRY | REFERENCE |
|---|---|---|---|---|---|---|---|
| 1 | | 44 | SI2:3 | 99 | | 146 | SI3:8 |
| 2 | | 45 | | 99a | | 147 | SI3:8 |
| 3 | | 46 | SI2:5 | 100 | | 148 | |
| 4 | | 47 | SI2:5 | 101 | | 149 | |
| 5 | | 48 | | 102 | | 149a | |
| 6 | SI1 | 49 | SI2:5 | 103 | | 150 | |
| 7 | | 50 | | 104 | SI3:5 | 151 | |
| 8 | | 51 | SI2:5 | 105 | | 152 | |
| 9 | | 52 | | 106 | | 153 | |
| 10 | SI5 | 53 | SI2:5 | 106a | | 154 | SI2:9 |
| 10a | SI2:1 | 54 | SI2:5 | 107 | | 155 | SI2:9 |
| 11 | | 55 | | 108 | SI2:8 | 156 | |
| 12 | SI1 | 56 | SI3:3 | 109 | SI2:8 | 157 | |
| 13 | | 57 | | 110 | SI3:9 | 158 | |
| 14 | | 58 | | 111 | SI3:9 | 159 | |
| 14a | | 59 | | 112 | SI2:7 | 160 | SI2:9 |
| 14b | SI3:13 | 60 | SI1 | 113 | | 161 | |
| 15 | | 61 | | 114 | | 162 | |
| 16 | | 62 | SI3:3 | 115 | | 163 | |
| 17 | SI2:9 | 63 | SI3:3 | 116 | | 164 | |
| 18 | | 64 | SI3:3 | 117 | | 165 | |
| 19 | SI2:9 | 65 | | 118 | | 166 | |
| 20 | SI5 | 66 | SI2 | 119 | | 167 | |
| 21 | | 76 | SI3:3 | 120 | | 168 | |
| 22 | | 77 | | 121 | | 169 | |
| 23 | | 78 | | 122 | | 170 | SI3:16 |
| 24 | | 79 | | 123 | | 171 | |
| 24a | | 79a | | 124 | | 172 | |
| 24b | | 79b | | 125 | | 173 | |
| 25 | | 80 | SI1 | 126 | SI3 | 174 | |
| 26 | | 81 | | 127 | SI3 | 175 | SI1 |
| 27 | | 82 | SI3:3 | 128 | | 176 | |
| 28 | | 83 | | 129 | | 177 | SI1 |
| 28a | | 84 | | 130 | | 178 | SI1 |
| 29 | | 85 | | 130a | | 179 | |
| 30 | | 86 | SI3:3 | 131 | | 180 | |
| 31 | | 86a | | 132 | | 181 | SI2:9 |
| 32 | SI2:5 | 87 | | 133 | | 182 | |
| 33 | SI3 | 88 | | 134 | | 183 | |
| 34 | SI3 | 89 | | 135 | | 184 | |
| 34a | | 90 | | 136 | | 185 | |
| 35 | | 90a | | 137 | | 186 | |
| 36 | | 91 | | 138 | | 187 | |
| 37 | | 92 | | 139 | SI1 | 188 | |
| 38 | SI2 | 93 | | 140 | | 189 | |
| 39 | SI2 | 94 | | 141 | | 190 | |
| 40 | | 95 | SI3:7 | 142 | | 191 | |
| 41 | SI7 | 96 | | 143 | | 192 | |
| 42 | | 97 | SI3:7 | 144 | | 193 | |
| 43 | | 98 | SI3:7 | 145 | | 194 | |



15

BIBLIOGRAPHY: SYSTEM-2000

| Code | Title or Description |
|---|---|
| SY1 | DATAPRO Reports System 2000, April 1980 |
| SY2 | Auerbach Publishers Inc. SYSTEM 2000. |
| SY3 | SYSTEM 2000/80 Customer Course Information |
| SY4 | SYSTEM 2000 UNIVAC Series Technical Summary. |
| SY5 | Computer World July 27, 1981 "End User Goes Data Base Without Programmers". |
| SY6 | Data Pro Software News April 1981. |
| SY7 | Discussion with Vendor. |

SOURCE CITATIONS: SYSTEM-2000

| ENTRY | REFERENCE | ENTRY | REFERENCE | ENTRY | REFERENCE | ENTRY | REFERENCE |
|---|---|---|---|---|---|---|---|
| 1 | | 44 | | 99 | | 146 | SY4:14 |
| 2 | | 45 | | 99a | SY2:5 | 147 | SY4:14 |
| 3 | | 46 | SY3 | 100 | | 148 | |
| 4 | | 47 | SY3 | 101 | | 149 | |
| 5 | | 48 | | 102 | | 149a | |
| 6 | | 49 | SY3 | 103 | | 150 | |
| 7 | | 50 | | 104 | SY4:1 | 151 | |
| 8 | | 51 | | 105 | | 152 | |
| 9 | SY2 | 52 | | 106 | | 153 | SY4:18 |
| 10 | | 53 | SY3 | 106a | | 154 | SY2 |
| 10a | | 54 | | 107 | | 155 | SY2 |
| 11 | | 55 | SY3 | 108 | | 156 | |
| 12 | SY4:22 | 56 | | 109 | | 157 | |
| 13 | | 57 | SY2:2 | 110 | | 158 | |
| 14 | SY3 | 58 | SY2:2 | 111 | | 159 | |
| 14a | SY4:28 | 59 | SY4:12 | 112 | | 160 | |
| 14b | | 60 | | 113 | | 161 | |
| 15 | | 61 | | 114 | | 162 | |
| 16 | SY4 | 62 | SY4:12 | 115 | | 163 | |
| 17 | SY1 | 63 | SY4:12 | 116 | | 164 | |
| 18 | SY4:4 | 64 | SY4:12 | 117 | | 165 | |
| 19 | SY4:4 | 65 | | 118 | | 166 | SY2:4 |
| 20 | SY4:1 | 66 | | 119 | | 167 | SY2:4 |
| 21 | | 76 | SY4:8,10 | 120 | | 168 | SY2:4 |
| 22 | SY7 | 77 | | 121 | | 169 | SY2:4 |
| 23 | SY7 | 78 | SY4:8 | 122 | | 170 | |
| 24 | | 79 | SY4:8 | 123 | | 171 | |
| 24a | | 79a | SY4:8 | 124 | | 172 | |
| 24b | | 79b | SY4:9 | 125 | | 173 | |
| 25 | | 80 | | 126 | | 174 | |
| 26 | SY4:5 | 81 | | 127 | | 175 | SY4:20 |
| 27 | SY4:11 | 82 | | 128 | | 176 | |
| 28 | SY4:8 | 83 | SY4:10 | 129 | | 177 | |
| 28a | | 84 | SY4:9 | 130 | | 178 | SY4:20 |
| 29 | | 85 | SY4:8 | 130a | | 179 | SY4:20 |
| 30 | | 86 | SY4:10 | 131 | | 180 | |
| 31 | | 86a | | 132 | | 181 | SY2:4 |
| 32 | SY4:14 | 87 | | 133 | | 182 | |
| 33 | SY4:14 | 88 | | 134 | SY4:6 | 183 | |
| 34 | | 89 | | 135 | | 184 | |
| 34a | SY2 | 90 | SY6 | 136 | | | |
| 35 | | 90a | SY4:21 | 137 | SY4:6 | [illegible] | SY2:4 |
| 36 | | 91 | | 138 | | 187 | |
| 37 | | 92 | | 139 | | 188 | |
| 38 | | 93 | | 140 | | 189 | |
| 39 | | 94 | | 141 | | 190 | |
| 40 | | 95 | | 142 | | 191 | |
| 41 | SY4:14 | 96 | | 143 | SY4:15 | 192 | |
| 42 | SY4:14 | 97 | | 144 | SY4:15 | 193 | |
| 43 | | 98 | | 145 | | 194 | |

USER AND VENDOR

INTERVIEWS

## INTERVIEWS: ADABAS-M

California
Computer: PDP 11/70 (RSX 11/M+)

The company obtained ADABAS-M because of an evaluation by two consultants and the company's in-house staff. Benchmark testing compared ADABAS-M and DRS (finalists) after an initial two level evaluation of 15 DBMSs for PDP computers.
ADABAS-M was chosen because of its flexibility, reliability and large data base capacity.

The system is doing what the vendor said it would do. They are pleased with the response time. It does lack an unload data base capability and an interruptable load capability.
It needs to be more forgiving. The ADABAS-M system seems to say "I can't go any further, you can guess why." Because of this there is an excessive need to call the vendor to read dumps. The vendor responds well when called.

They were one of the first users of ADABAS-M in the U.S., but still are not completely aware of how to use the system effectively.

ADASCRIPT-M, the query tool is insufficent, also it is rudimentary. The company, however, has little need for a vendor supplied query function.

The data dictionary is very good. It permits access of anything in interactive mode only.
A data base reload is needed when an element is added to the data base definition.

Idaho

Computer: VAX 11/780

ADABAS-M has been in house since about last September. It was chosen because a "no pointer" system was desired. (A member of the staff had used ADABAS on an IBM computer.) The system was evaluated against SEED (pointer), DBMS-32 (pointer), and ORACLE (relational). Two systems were rejected for being pointer systems and ORACLE was rejected because it was too slow.

The compatibility mode implementation limits VAX functionality.
Documentation is limited.
The users group is effective and communicates information well.
The ADABAS-M implementation is incompatible with the company's time-sharing billing process. <It is not clear whether this is an ADABAS-M or a company problem.>

A report writer will be available shortly.
The data directory schema works. It is flexible as to modification and user views.

The system's strengths are speed of search, rapid response, and stability to function properly.
Weaknesses include lack of documentation. For example, there are no hints of how to tune or optimize the system.

The system is user friendly when the added optional feature NATURAL is obtained. The user was able to write a program in 45 minutes with NATURAL that would have 6 to 8 hours in COBOL. This was without prior exposure to NATURAL.
Software AG's other query language, ADASCRIPT-M, is useless.

Virginia (DC Area)
Computer: VAX

ADABAS-M was installed during November 1981.
It was chosen because of its large capacity.
It was chosen after comparison with TOTAL, System 2000, IMS and others.

They have over 2000 files which are much greater than the ADABAS-M system limit. They were able trick the DBMS into accepting the large number of files.

There is no query capability.
The data dictionary is useful. It is on a par with others.
Changing the data structure is difficult because of the number of files.
A major weakness is the use of PDP architecture rather than the VAX architecture. For example, the PDP instructions and paging are used in implementation.



10

## INTERVIEWS: BASIS

Ohio

Computer: Cyber (Control Data Corportation)

BASIS was chosen by the company because of its portability and its ability to process textual data. The company has used BASIS on a time sharing computer since January 1981. They are in the process of obtaining a license for BASIS for their own computer.

BASIS was compared with DBMS 170 (for CDC computers) and System 2000. BASIS was found to require significantly less computer resources than the other systems.

When compared to System 2000, BASIS was found to be harder to use from the system side, but much easer from the user side. The company felt it better to train a DBA for BASIS than to be continually teaching new System 2000 users how to query the system.

BASIS is a good DBMS. It has better textual features than either INQUIRE or ORBIT. BASIS uses an inverted structure. It only uses space for the number of repeating groups which are used. System 2000 reserves space for all groups even when only one group has data. BASIS has only a few levels of hirearchy while System 2000 has 32 levels.

They do not use the data directory capability. The user stated that the System-2000 DESCRIBE may be a similar function. The user stated that BASIS has a similar capability.

The strength of the BASIS system was that it was friendly to the users.

The weakness being the added effort to bring the system up and the requirement for a more highly trained DBA.

The 13 term THESAURUS is a very useful feature.
The system has overall efficiencies over System-2000.
When questioned about the use of two DBMSs, the user stated that data could be unloaded from System 2000 then loaded onto BASIS without difficulty. <The remark implies both systems have good bulk load and unload features.>

The concluding remark was that BASIS did all that was asked and then some.

Ontario
Computer: VAX 11-780

The DBMS is used for a textual search application. Their needs are for Reference, Citation, and New Article.
The system was easy to bring up (less than an hour). But BASIS was not new to them.

OLIVE (the on-line editor) and FORMS are used for entry of information.
The data is saved along with a relationship index for later searches. It is stored in a mother-daughter relationship. An example of the mother-daughter relationship is; a conference is the mother item and the articles are the daughter items <hierarchcial structure>.
More than 100 fields are indexed within the data base.

The security is good but the company has added extra features.

BASIS was benchmarked against INQUIRE <for IBM computers>. BASIS won because of better performance, flexibility and portability.

The stored query capability is good.
The strength of the system is in its comprehensive ability to manipulate data.

BASIS is weak in the organization of documentation. Another weakness is that OLIVE does not contain a full screen editor.

California
Britton-Lee IDM-500

The company is building a channel interface, block multiplexor to link the IDM-500 to the UNIVAC Series 1100 computer.
They are the largest independent supplier of equipment compatible with UNIVAC computers.

They are developing the software to permit ASCII/FORTRAN interface between the IDM-500 and the UNIVAC computers. The software will allow queries in an ad-hoc manner.
The data base software will be fully relational. The software will use the Britton-Lee IDL language.

The company expects to make first deliveries during April or May 1982. No pricing information was available at that time.

California
Computer: Britton-Lee IDM-500

The company is connecting an IDM-500 to the UNIVAC Series 1100 computer. It transfers data in byte or word parallel.

It uses an intelligent terminal and ISI 3803 channel adapter.

Software will be provided; initially consisting of imbedded CALLs to Britton-Lee's IDL. This will be followed by a DML and SQL compiler capability.

The system will be plug compatible by use of a GPIB (IEEE-488) parallel interface.

The company representative states that delivery will be six months after receipt of the order.

The quoted price is $226,000. It includes the basic IDM-500 with three 200 megabyte disk drives, all software and software licences. The data base accelerator is not included in this package. Maintenance on the above package is $2185 per month.

He suggested that the Britton-Lee one week classes in both hardware and software are useful.

## INTERVIEWS: DMS-1100

Washington DC
Computer: UNIVAC 1100 Series

Two DMS-1100 users were interviewed, both of which were also System 2000 users. Both state that:

- o System 2000 is much easier to use and that it is preferred when either System 2000 and DMS-1100 can be used in implementing a new function.

- o Several capabiliities are not available on System 2000. When a new function needs one of these capabilities DMS-1100 must be used.

- o These capabilities include:

  - Multi-user interaction with the DBMS.
  - Complex data structures.
  - Network structures.
  - A sub-schema which differs from the schema.
  - Large or complex problems.

- o There was no mention of capabilities in System 2000 which do not exist in DMS-1100.

## INTERVIEWS: SQL/DS

New York
Computer: IBM 43xx series

Because it is in final development, there are no normal users of SQL/DS. Some number of beta test sites are using pre-release versions. Because of agreements with these pre-release users the company is unable to disclose their identities.

London, United Kingdom
Computer: Honeywell 66/60

The company has used both IDS and RAPPORT. They have used RAPPORT for over two years.
It was chosen because it was the only Relational Data Base Management System for Honeywell computers. Also because RAPPORT contained similarities with IDS.
RAPPORT is like IDS in language style and in the capability to navigate from relation to relation. < His statement not Mc2's.>

RAPPORT met their expectations within limits. It was a good implementation.

The DBMS was fairly easy to learn.

It became easy to use after they got used to it.

The query works. One of their systems is written entirely in IQL. <No host language>
The data dictionary capability is limited. For example, there is no 'working storage' description. The user must do his own packing and unpacking of data elements.

Because of the existence of a utility program, modification of the data structure is not too difficult.

The system security feature is not used because the company's needs are met by the Honeywell file controls.

They consider RAPPORT reliable. Only one bug has been found in two years.

The OR operation has not yet been not implemented. It is planned for the

next release.

Because of the operation of Honeywell time-sharing, there is no way to run RAPPORT in the multi-user environment. COBOL cannot be used because it requires the multi-user time shared environment.

Wallsend, United Kingdom
Computer: ICL 1904

RAPPORT was chosen because it was the only Relational Data Base Management System available. It was installed two and one-half years ago.

The programmers had little difficulty in learning how to use RAPPORT.

The query did not work with release 1.01. It should be available in release 1.02. It will be used in the future.
HELP is a good feature. It permits listing of valid options and valid fields.

The person in charge of the data base structure was able to change the size of a relation without the users knowing that the change was made.

They have no need to use the security controls or constraints.
Multiple ship designs require the use of multiple data bases.

The system is considered to be user friendly.
It is simple, powerful and supports relational analysis.
There are no major weaknesses, but there are several small ones. For example the preprocessor is slow. Logica is aware of this problem and is rewriting the pre-prosessor.
(The user has sufficient confidence in the vendor promise, that he is sure the new pre-processor will be available in the near future and will be much better than the existing one.)

United Kingdom
Computer: UNIVAC Series 1100/21

The user's reasons for obtaining RAPPORT were that RAPPORT could be implemented in small parts while DMS-1100 must be implemented as a total unit, causing great impact upon their staff. In addition, the relational structure was of value because of the necessity for frequent changes to the data structure.
RAPPORT has been in use almost 2 years.

The user stated that it met expectations with one major exception: The multi-user capability did not work because of a glitch in UNIVAC's "commom bank". This problem has been by-passed by the implementation of a routine obtained from another user. They felt that if they better understood the system they could have fixed it themselves.

The system was easy to learn and to use. (It obviously is easy to use on a casual basis but, like all complex tools, it requires significant expertise to work around system problems and to perform very complex functions.)

The query feature is good but has limits.

Modification of the data structure is fairly simple. FORTRAN or utilities are used for this purpose.

The company has no need for security controls and did not obtain the security portion of RAPPORT.

The JCL is useful and simple relative to the IBM JCL.

Strong features are ease of accessing and correcting data and the ability to write common sequences (stored queries).

## INTERVIEWS: SIBAS

Numerous attempts, including consultation with the vendor, were unsuccessful in identifying users of SIBAS.

Maryland
Computer: UNIVAC 1100

The company has both System 2000 and DMS-1100.
System 2000 is easier to use and is prefered when either System 2000 or DMS-1100 will perform a newly needed function.
In most cases System 2000 is used for small simple applications, while DMS-1100 is used for long applications or applications which require network structures.
There is no multi-thread capability in UNIVAC System 2000, but is expected soon.

System 2000 uses 'strings'. The strings are stored queries which are loaded via key words.

The System 2000 structure can easily be changed when no "key" values require change.

System 2000 was obtained about three years ago. The respondent does not know the reasons for choosing System 2000.

Virginia
Computer: UNIVAC Series 1100

"System 2000 is different, but not necessarily better."
It is easy to use, easier than most.
Update capability is not important to the user.
System 2000 retrieval capabilities are good.

The user cannot be ignorant of data processing procedures, but any person who understands the use of files and high level languages such as 'Report Writer' should be able to use System 2000 with about a half-day training.

Because of the security requirements there is no interactive use of System 2000 at the computer site.
The System 2000 security package has been locally enhanced.

Washington, DC
Computer: UNIVAC 1100

The organization uses System 2000 release 2.90 with some features of release 2.92. Release 2.95 will be implemented soon.
The system is very stable to the user. Some bugs do exist, but these bugs can be worked around.

They also have DMS-1100. System 2000 is easier to use than DMS-1100.
The multi-user, multi-thread version was part of release 2.80 of the UNIVAC version of System 2000. This feature has been withdrawn from use. It will be reimplemented shortly.
System 2000 documentation is relatively good.
System 2000 is easier to use than is DMS-1100.
System 2000 has no networking capability. (The vendor literature discusses

'dynamic' networking under user control).
System 2000 has no sub-schema feature.

DMS-1100 is used for problems which require network structures or multi-user accessibility. System 2000 is used when there is no need for multi-user capability and when a hierarchical structure is sufficient to solve the problem.
System 2000 was obtained during the 1972-1974 period.
The respondent was not involved in the decision to obtain System 2000.

(Query by Example) is a new product which has been used very little.
QUEST has a good natural language query capability.
System 2000 does not have a test mode.

They do not have a Data Dictionary at the site. They do not believe it to be useful.

System 2000 is used for a central data base and ten regional data bases (all at the central site). A typical function is to track money by area for various activities such as "section 8".
The regional data bases can be accessed by area.

## INTERVIEWS: MRDS

D.C. Area
Computer: Honeywell 68/80

The system works well with a small data base. With a large data base the system is slow because of excessive page swapping.

The Logical Inquiry and Update System (LINUS) is valuable to the infrequent user, but not worthwhile to the normal system user.

The major system strength is the flexibility in supporting different programming environments.

A weakness is that general purpose computer systems (even ones as powerful as MULTICS) are not good as word processors.

Relational Data Base Management Systems should not be implemented on general purpose computers. In order to work effectively they must be supported by special purpose function hardware.

The user stated that the system is very popular. It was installed 3 years ago with CPUs. The acceptance of the MULTICS system (not necessarily MRDS) has caused the upgrade to ten CPUs. He believes that the computer's popularity will require the number of CPUs to double in the not distant future.

New York
Computer: Honeywell 6180

MRDS can be used at 3 levels:

- MRDS uses subroutine calls from within FORTRAN and PL/1

application programs.

- LINUS is used at terminals for user queries (and updates).

- M-RPG is a report writer which translates to PL/1 code.

The organization has both MRDS/LINUS and JANUS.

MRDS/LINUS is hard to use relative to JANUS. It is awkward to set up because users must build command strings prior to issuing queries.

They are not using the most recent version of MULTICS. There are several desirable features in the next release such as an interface to Artificial Intelligence Corporation's INTELLECT and an increase in the maximum allowable number of attributes in a file.

The user seldom uses MRDS because JANUS is more convenient. He does not know of any frequent MRDS users at the installation.

## 3.2 DBMS Evaluation

Following the Survey task, an evaluation was performed during which the the AMIP requirements were used as a basis for determining the most appropriate DBMS. While during the preceding task a general survey was performed to characterize the DBMSs, during this task those characteristics which apply to the problem at hand are evaluated according to a methodology based on weighting according to importance.

### 3.2.1 Evaluation Methodology

Selecting the candidate DBMSs involves three major Steps:

(1) Define desired DBMS functions and their relative importance to AMIP data base management needs.

(2) Rate each DBMS against the desired functions on 0-10 basis, with 10 scoring highest.

(3) Total the scores based on the relative importance of the function.

These three steps are discussed further in the following sections.

#### 3.2.1.1 Define Functions

In this step of the methodology, the desired DBMS functions are identified. Each function is defined in terms of sub-functions and each sub-function, in turn, is defined by its components. Relative weights of importance are assigned at the function and sub-function level. These



115

weights are based on importance of the function to AMIP requirements and are expressed in a percentage basis. At the function level, the weighting expressed the importance of the function to the overall evaluation. Weighting of the sub-functions expresses their importance to a "parent" function. Weighting stops at the sub-function level. A sub-function's constituent components are not weighted; rather, they serve as a type of "checklist" for the sub-function. This top-down analysis of desired functions provides a framework for scoring and evaluating the systems in a manner consistent with AMIP application requirements.

3.2.1.2 DBMS Ratings

Each DBMS is rated on a 0 to 10 scale for each sub-function on its capability to fulfill the components of the sub-function. This number is derived from a checklist formed from the sub-function's components. A midpoint score of 5 is given if the system can supply the capabilities defined in all of the sub-function's components. Points are added or subtracted from the midpoint score for exceeding or falling short of the requirements. Although the scoring is performed on a generally subjective basis, the checklist provides a starting point for score assignments. All of the data used to prepare the checklist and to determent the subjective judgments originate from the footnotes in the General Survey of DBMSs (see Section 3.1).

3.2.1.3 Total Scores

The scores for each DBMS are calculated in the following manner:

(1) For each function do steps 2 to 4.

(2) For each sub-function in a function multiply the sub-function's score by its weight. Save these scores.

(3) Sum the sub-function scores determined in (2).

(4) Multiply the sum of (3) by the function's weight. Save these scores.

(5) Sum the numbers from step (4) for all functions to obtain the total score for the DBMS.

#### 3.2.1.4 Final Evaluation - A Caution Note

Total scores should be viewed as guidelines to be used in the evaluation and selection process, rather than an absolute criterion. Although the final scores were developed from a formal methodology, these numbers were derived from subjective judgments, not rigorous quantitative measures. Where appropriate, these scores should be used cautiously and in conjunction with other applicable selection criteria (e.g., system maturity, availability) to arrive at the final selection. Accordingly, the tabular presentation of "scores", is accompanied by subjective discussion and consideration leading to a final choice.

### 3.2.2 Discussion of Evalution Criteria

#### 3.2.2.1 Volume and Performance Characteristics

As has been discussed in Section 1.0, none of the models, separately or in combination, require data in such volume as to strain the capacity of any of the DBMSs being evaluated. Moreover, except for two possible, but unlikely, cases no foreseeable expansion of the models or their use, will approach the capacity of any of the DBMSs. The two exceptions are terrain and weather data. Terrain and weather data model requirements have been calculated based upon current Army modeling procedures. Currently, a representative land area involved in the modeling exercise is 600 x 600 kilometers. Data base volume requirements developed in Task 1 use this figure. Terrain and weather data are loaded from tape to on-line (disk) storage, under control of the data management software, for the area in question. It is felt, at this time, that the only available DBMS capability desirable in support of the process is a bulk load capability

to facilitate loading of appropriate data from tape when an exec begins. This capability is deemed only "desirable" in a DBMS rather than "necessary" because the implementation of software to support these two specific bulk load operations would be a relatively minor effort.

Another desirable feature for support of this application would be DBMS control of a tape library. Such a capability would provide user (or program) access to data resident on tapes in a transparent manner. With such a capability the user could specify (via QUERY selection criteria) which data was desired, as is normally done for disk resident data, under control of the DBMS. In the case of tape resident data, the data location control (e.g., indexes) would indicate a reel number (or numbers) rather than a disk address. The DBMS would automatically issue reel mount instructions to the operator and proceed to search the tape sequentially. A more sophisicated version could perform fast-forward tape positioning if tape block numbers were recorded.

This capability does not reside in any of the DBMSs surveyed. To our knowledge, only one DBMS has this capability - Data Manager-1 (DM-1), written in JOVIAL on the Honeywell 635/645 computer under the GCOS operating system for the Air Force. DM-1 was never commercially available and has not been used since 1975.

Task 1 investigations at the participating agencies, including interviews and analysis of Univac Accounting System printouts containing system resource utilization statistics taken during representative loading periods, have indicated that neither CPU nor I/O processing requirements are at the present time approaching saturation of existing resources. An increase in loading by a factor of at least two could be tolerated before significant degradation in on-line response would be experienced.

It was decided, then, that data base volume capabilities of the DMBS was not a useful evaluation criterion since it is expected that all of those surveyed can meet present and future requirements. Efficiency also is not

considered an overriding issue except in the extreme case of a DBMS being grossly inefficient. Interviews with users have to date uncovered no substantial complaints regarding efficiency and, indeed, one would not expect a product to survive in the marketplace if there were processing inefficiencies of a magnitude great enough to seriously degrade the application at hand (i.e., 100 + percent).

3.2.2.2 Control and Standardization

The consideration perceived as major in the evaluation of DBMSs for support of the Army Model Improvement Program is the issue of control and accountability. This perception is based upon the existance of numerous sources of data, the varying formats and subsets of the data required by the different models, and the numerous versions of the data required by the users of the models. It is reinforced by the stated goal of the Army to implement a standard data format so that all users can extract needed data from a well established repository having known characteristics (Task 6 of the AMIP Master Plan). Establishment of this standard format will make possible comprehensive automatic data extraction procedures, thus eliminating much of the laborious and time consuming manual extraction currently necessary. It will also greatly lower the opportunity for confusion and error inherent in a system burdened by a multiplicity of formats and procedures. Figure 3-1 shows control potential provided by a DBMS.

A form of control related to standardization of format is standardization of content. Many DBMSs provide the capability for the user to specify the nature of the data to be entered into the data base and will reject data not conforming to that specification. Thus, an element of the data base which has been specified as numeric only cannot be loaded with alphabetic values. Further, a data element which has been specified as having a permissable range of, for example, 0-400 cannot be loaded with negative numbers or numbers greater than four hundred. Some DBMSs provide the capability to define lists of acceptable alpha-numberic codes or names and will accept no others. This capability promises to be of great value in the AMIP for preventing data contamination which could result in erroneous values being used in the models or in data being unreachable or invisible to the user due to garbling of a crucial search key.

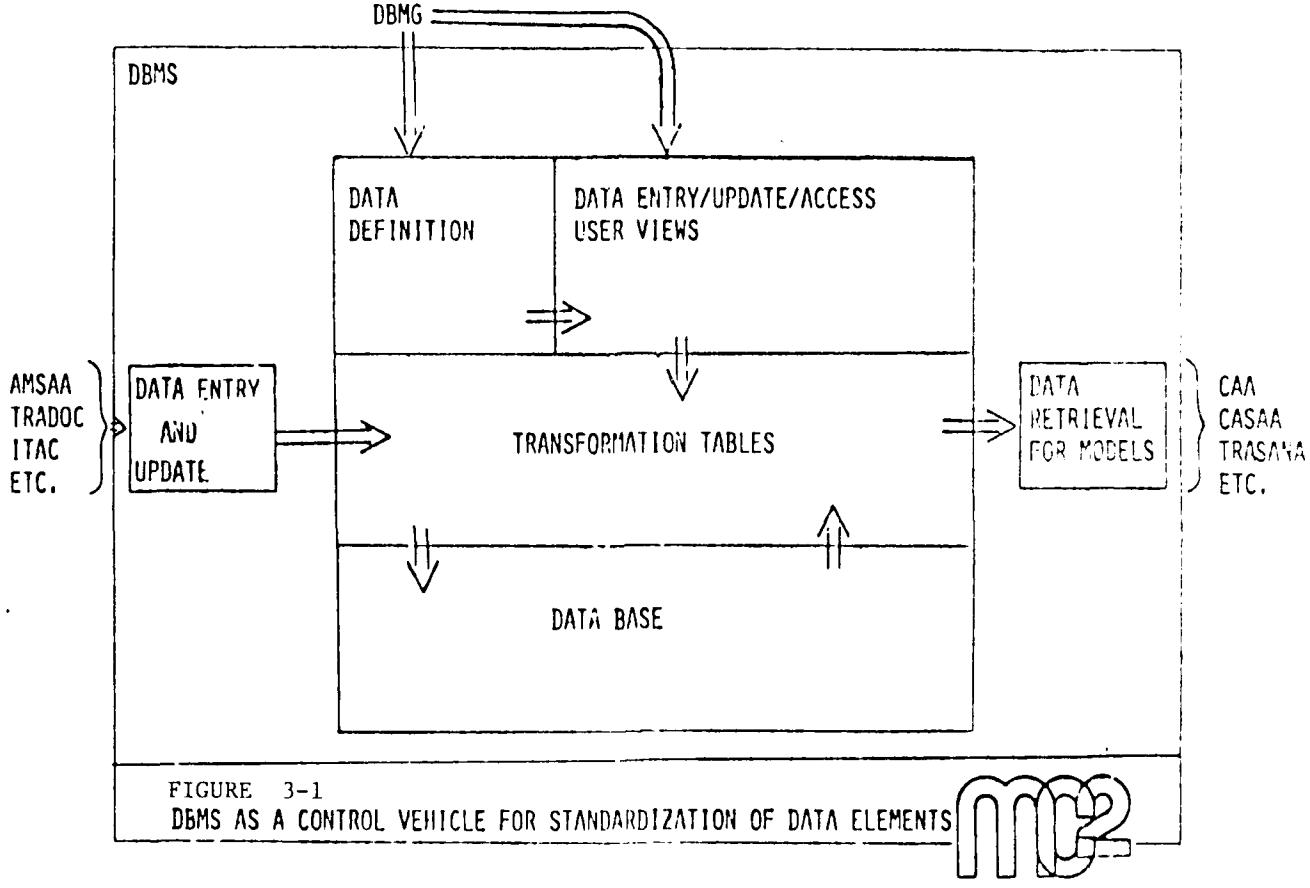



FIGURE 3-1
DBMS AS A CONTROL VEHICLE FOR STANDARDIZATION OF DATA ELEMENTS

A third aspect of control of a data base is the control over who may access it for read or update. This area, called variously security, privacy, permissions and integrity, depending upon who is discussing it and what their major interest is, is often confused in the mind of the evaluator. To some it means security in the sense of protection from a concerted effort by unauthorized personnel to gain information to which they have no right or to sabotage the data base. No DBMS can provide this protection to a degree sufficient for military certification. Indeed, no computer system has yet withstood the efforts of the DoD special team whose job it is to subvert military computer systems' security safeguards. The issue of "multi-level security" is an ongoing one.

The form of security addressed in this evaluation is provision against inadvertant or casual unauthorized access to data. DBMSs provide various levels of unauthorized access protection. Levels involving access to the data structure are most common and are probably most applicable to the AMIP. These include read and/or write access permissions at the data base, file, record type, set type, and field levels. Less common are access controls based on the data itself. Thus, access to a data base, file, record type, set type or field may be denied based upon the contents of a field or fields. This capability is seen as having less value to the AMIP. It has more application in systems where total integration of data is necessary for high level applications, for instance an executive management information system requiring all data, but where lower level functions such as payroll are used by personnel who should be restricted from access to the salary information of selected individuals. This element of "secrecy" is not present at the modeling agencies.

A final form of control over the data base is that of accountability. To maintain control over the contents of the data base it is necessary that the data base administrator have knowledge of originating sources, an audit trail of data base modifications, and pointers to supporting reference material where appropriate. Two features potentially available in a DBMS to support these requirements are a dictionary/directory and

audit trail logging. By our definition, all DBMSs contain a dictionary/directory. A dictionary/directory contains at least the definitions of the data base structure, such as format and relationships of data, that are necessary information that the DBMS must have to manage the data. On the other hand, a dictionary/directory can contain information about the data base which goes beyond that required by the DBMS itself and is in support of the data base administrator (information such as source of data or supplying agency). For a DBMS having otherwise superior capabilities, but whose dictionary/directory is inadequate, separate dictionary/directory packages should be considered if they can be integrated with the DBMS.

The discussion above presents the basic rationale for selection of evaluation criteria. In general, the evaluation concentrates on functional capabilities rather than performance or efficiency.

3.2.2.3 Evaluation Criteria Definitions

Data base management technology, being a new and rapidly expanding science, is fraught with divers terms and concepts the meanings of which are often misunderstood, understood differently, defined in conflicting contexts, and which are, in general, open to discussion. It is necessary, therefore, when presenting an evaluation keyed to these terms, to state the evaluators' definitions of the terms and the context in which they are used.

The definitions of evaluation criteria are included at the bottom of this report to promote understanding of the evaluation.

### 3.2.3 Evaluation Scores

The following pages present the results of the scoring of the DBMSs. They are arranged in the following structure:

- Weighting Assignments
- For each component:
  - Component Answer page transcribed from the General Survey
  - Component scores and notes
- Overall evaluation scores, weighted and suummed

## AMIP DBMS Evaluation Weighting

| EVALUATION CATEGORY | FUNCTION SUB-FUNCTION | WEIGHT |
|---|---|---|
| 1.0 | USER/APPLICATION FUNCTIONS | 20% |
| 1.1 | Update and Load | 70% |
| 1.2 | Query and Report | 30% |
| 2.0 | SYSTEM CONTROL FUNCTIONS | 15% |
| 2.1 | Recovery | 50% |
| 2.2 | Concurrency Control | 25% |
| 2.3 | Security | 25% |
| 3.0 | ADMINISTRATIVE FUNCTIONS | 50% |
| 3.1 | Data Dictionary | 50% |
| 3.2 | Validity Checking | 30% |
| 3.3 | Reorganization | 10% |
| 3.4 | Monitoring | 10% |
| 4.0 | OTHER | 15% |
| 4.1 | Documentation and Vendor Aids | 80% |
| 4.2 | Portability | 20% |

Component - 1.1 Update and Load

| DBMS | Bulk Load | Relational Operators | Boolean Logic | Host Language Interface |
|---|---|---|---|---|
| ADABAS-M | Yes | Yes | Yes | Call |
| BASIS | Yes | No | No | Call |
| IDM-500 | No | Yes | Yes | Call |
| DMS-1100 | No | No | No | DML |
| SQL/DS | Yes | Yes | Yes | DML |
| RAPPORT | Yes | Yes | Yes | DML |
| SIBAS | No | No | No | DML |
| S-2000 | Yes | Yes | Yes | DML |
| MRDS | Yes | Yes | Yes | Call |

Scoring Procedures

The elements of this component are graded objectively: simple [illegible] "No" answers for the first three columns receive either 2 points or none. The fourth column is graded as follows:

"No" = 0, "Call" = 2, "DML" = 4.

UPDATE AND LOAD EVALUATION SCORES

| DBMS | Score (10 Perfect) | Weighted Score (70%) | Remarks |
|---|---|---|---|
| ADABAS-M | 7 | 4.9 | 1 |
| BASIS | 4 | 2.8 | 2 |
| IDM-500 | 6 | 4.2 | 3 |
| DMS-1100 | 4 | 2.8 | 4 |
| SQL/DS | 10 | 7.0 | 5 |
| RAPPORT | 10 | 7.0 | 6 |
| SIBAS | 4 | 2.8 | 7 |
| S-2000 | 10 | 7.0 | |
| MRDS | 7 | 4.9 | 8 |

1. No Data Manipulation Language
2. FORTRAN calls to BASLIB can be issued. On-line update requests for data set in "QUEUE" file. Batch program later updates data base. (Requests for Data cause search of both data base and "QUEUE" file. Required fields, Range checking, Table Look ups.
3. Complete OEM implementation will have all components Boolean, DML and relational operators.
4. Existence of required fields.
5. COBOL and PL/1 only; no FORTRAN.
6. OR will be added to future version.
7. 1979 version SIBINTER contains convenient form for calls. There is no indicaiton that later version exists. Data Manipulation Language (DML) exists for COBOL; FORTRAN (and others) use CALL.

Component - 1.2 Query and Report

| DBMS | Relational Operators | Boolean Logic | Sorted Results | Built-In Summary Functions | Non Procedural Language | Report Generator | Stored Query |
|---|---|---|---|---|---|---|---|
| ADABAS-M | Yes | Yes | No | Yes | No | Limited | Yes |
| BASIS | Yes | Yes | No | Yes | Yes | Yes | Yes |
| IDM-500 | Yes | Yes | Yes | Yes | Yes | Implementable | Yes |
| DMS-1100 | Yes | Yes | No | Yes | No | Yes | Yes |
| SQL/DS | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| RAPPORT | Yes | Limited | Limited | No | Yes | No | No |
| SIBAS | No | No | No | No | No | No | No |
| S-2000 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| MRDS | Yes | Yes | No | Yes | Yes | Yes | No |

Scoring Procedure

The elements of this component are somewhat subjectively graded according to the degree of compliance perceived by the reviewer. "Relational Operators", "Boolean Logic", and "Stored Query" were seen as most valuable of the set to AMIP and were accordingly assigned maximum point values of 2 each. All other elements were assigned one point each. This, however, is more in the spirit of a guideline than a strict rule.



156

QUERY AND REPORT EVALUATION SCORES

| DBMS | Score (10 Perfect) | Weighted score (30%) | Remarks |
|---|---|---|---|
| ADABAS-M | 5 | 1.5 | 1 |
| BASIS | 7 | 2.1 | |
| IDM-500 | 8 | 2.4 | |
| DMS-1100 | 7 | 2.1 | |
| SQL/DS | 9 | 2.7 | |
| RAPPORT | 5 | 1.5 | 2 |
| SIBAS | 0 | 0.0 | |
| S-2000 | 9 | 2.7 | 3 |
| MRDS | 7 | 2.1 | |

1. Hit count and Histogram only. Full report generators for ADABAS-M available from other vendors.

2. Results not in sorted order can be placed in temporary file then sorted. OR in future version.

3. Many reports with single access of data base.

Component - 2.1 Recovery

| DBMS | Audit Log | Save/ Restore | Update Rollback | Transaction Rollback |
|---|---|---|---|---|
| ADABAS-M | Yes | Yes | No | No |
| BASIS | See Remark | Yes | N/A | N/A |
| IDM-500 | Yes | Yes | Yes | Yes |
| DMS-1100 | Yes | Yes | Yes | in QPL |
| SQL/DS | Yes | Yes | Yes | Yes |
| RAPPORT | Yes | Yes | Yes | Yes |
| SIBAS | Yes | Yes | Yes | See Remark |
| S-2000 | Yes | Yes | Yes | Yes |
| MRDS | No | No | No | No |

Scoring Procedure

The elements of this component were graded equally, but some subjective judgement was called for on the part of the reviewer concerning completeness and or ease of use of the capability provided.

RECOVERY EVALUATION SCORES

| DBMS | Score (10 Perfect) | Weighted Score (50%) | Remarks |
|---|---|---|---|
| ADABAS-M | 5 | 2.5 | 1 |
| BASIS | 4 | 2.0 | 2 |
| IDM-500 | 7 | 3.5 | |
| DMS-1100 | 7 | 3.5 | |
| SQL/DS | 9 | 4.5 | |
| RAPPORT | 9 | 4.5 | |
| SIBAS | 7 | 3.5 | 3 |
| S-2000 | 9 | 4.5 | |
| MRDS | 0 | 0 | |

1. Logging is to a recycling disk journal which supports concurrent archiving.

2. Updates made to "queue" file. Batch later performs update from "queue".

3. Update made to log file, Finish command causes transactions to be copied to data base.

Component - 2.2 Concurrency Control

| DBMS | Level of Shared Access | Multi-User | Multi-Threading | Deadlock Provisions |
|---|---|---|---|---|
| ADABAS-M | Record | Yes | Yes | Yes |
| BASIS | N/A | No | No | N/A |
| IDM-500 | Relation | Yes | Yes | No Data |
| DMS-1100 | Area | Yes | Yes | Yes |
| SQL/DS | Record | Yes | No Data | Yes |
| RAPPORT | Element | Yes | No | Yes |
| SIBAS | Realm | Yes | No | Yes |
| S-2000 | File | Yes | Yes | No Data |
| MRDS | Record | Yes | No | Yes |

Scoring Procedure

A "Multi-User" capability was considered the most important element of this component and was assigned a possible 5 out of 10 points. Its score was determined based upon the depth ("level") of shared access supported, deeper being better. Scores for "Multi-User" were based upon the column "Level of Shared Access", as follows:

No - 0
File/Relation = 1
Set = 2 (none found)
Area/Realm = 3
Record = 4
Element = 5

"Multi-Threading" had 2 points and "Deadlock Provisions" 3 possible points. "Multi-Threading" would carry more weight in an environment where performance efficiency was critical.

CONCURRENCY CONTROL EVALUATION SCORES

| DBMS | Score (10 Perfect) | Weighted Score (25%) | Remarks |
|---|---|---|---|
| ADABAS-M | 8 | 2.00 | 1 |
| BASIS | 0 | 0.00 | 2 |
| IDM-500 | 4 | 1.0 | |
| DMS-1100 | 7 | 1.75 | |
| SQL/DS | 7 | 1.75 | 3 |
| RAPPORT | 8 | 2.00 | |
| SIBAS | 6 | 1.50 | 4 |
| S-2000 | 4 | 1.00 | |
| MRDS | 7 | 1.75 | |

1. Record level lock with thme-out to prevent dead-lock. 250 threads.

2. No deadlock provision needed because updates placed on "queue" file.

3. IBM does not give much information about how software works.

4. Users may share realm, but can lock records with in the realm.



1.2

Component - 2.3 Security

| DBMS | Level of Protection | Read Permission | Write Permission | Password |
|---|---|---|---|---|
| ADABAS-M | Element | Yes | Yes | Yes |
| BASIS | Element | Yes | Yes | Yes |
| IDM-500 | View | Yes | Yes | No |
| DMS-1100 | Record | Yes | Yes | Yes |
| SQL/DS | Element | Yes | Yes | Yes |
| RAPPORT | Element | See Remark | Yes | Yes |
| SIBAS | Record | Yes | Yes | No |
| S-2000 | Element | Yes | Yes | Yes |
| MRDS | File | Yes | Yes | No |

Scoring Procedure

The elements of this component were graded objectively on "Yes/No" answers with minor adjustments. "Read Permission" and "Write Permission" were graded according to "Level of Protection", deeper being better. "Element" Levels of Protection yielded a "4" for these two columns. "View" or "Record" Level of Protection yeilded a "2". "File" Level of Protection was graded at "1". Password capability was assigned a value of "2".

SECURITY EVALUATION SCORES

| DBMS | Score (10 Perfect) | Weighted Score (25%) | Remarks |
|---|---|---|---|
| ADABAS-M | 10 | 2.50 | 1 |
| BASIS | 10 | 2.50 | |
| IDM-500 | 5 | 1.25 | 2 |
| DMS-1100 | 6 | 1.50 | |
| SQL/DS | 10 | 2.50 | |
| RAPPORT | 7 | 1.75 | 3 |
| SIBAS | 5 | 1.25 | |
| S-2000 | 10 | 2.50 | |
| MRDS | 2 | 0.50 | |

1. Password for File.

2. The OEM vendors should supply security packages as part of the enhancements.

3. If read access is not available to a field then its value is replaced with default value. No error message is given. Incorrect results possible when default is used in later calculations.

Component - 3.1 Data Dictionary

| DBMS | Self Contained | Schema Capability | Sub-Schema Capability | User View Creation | User Query Dictionary | User Update Dictionary |
|---|---|---|---|---|---|---|
| ADABAS-M | Yes | Yes | Yes | No | No | No |
| BASIS | Yes | Yes | No Data | No | Yes | No |
| IDM-500 | Yes | Yes | Yes | Yes | Yes | Yes |
| DMS-1100 | Yes | Yes | Yes | No | No | No |
| SQL/DS | Yes | Yes | Yes | Yes | Yes | Yes |
| RAPPORT | Yes | Yes | No | No | No | No |
| SIBAS | Yes | Yes | Partial | No | No | No |
| S-2000 | Yes | Yes | No Data | No | No | No |
| MRDS | Yes | Yes | Yes | Yes | No | No |

Scoring Procedure

"Schema Capability" carried the heaviest possible weight - "5". All others were scored "0" or "1" based on "Yes" or "No". The score for "Schema Capability" was assigned based on the reviewer's perception of the comprehensiveness and power of the Schema Language (DDL) provided.

DATA DICTIONARY EVALUATION SCORES

| | | | |
|---|---|---|---|
| ADABAS-M | 5 | 2.5 | |
| BASIS | 3 | 1.5 | |
| IDM-500 | 7 | 3.5 | |
| DMS-1100 | 5 | 2.5 | |
| SQL/DS | 8 | 4.0 | 1 |
| RAPPORT | 3 | 1.5 | |
| SIBAS | 4 | 2.0 | |
| S-2000 | 4 | 2.0 | 2 |
| MRDS | 8 | 4.0 | |

1. Users can update their views of the data base.

2. Data dictionary is part of nucleus.

## Component - 3.2 Validity Checking

| DBMS | Format | Range | Legal List | Unique-ness | Required Element |
|---|---|---|---|---|---|
| ADABAS-M | Yes | No | No | No | No |
| BASIS | Yes | No | Yes | Yes | Yes |
| IDM-500 | Yes | No | No | Yes | No |
| DMS-1100 | Yes | Yes | Yes | Yes | No |
| SQL/DS | Yes | No | No | No | Yes |
| RAPPORT | No | No | No | Yes | No |
| SIBAS | No | No | No | Yes | No |
| S-2000 | No | No | No | No | No |
| MRDS | No | No | No | No | No |

Scoring Procedure

The elements of this component were scored subjectively according to the reviewer's perception of their comprehensiveness. In general, the elements increase in weight from left to right.

VALIDITY CHECKING EVALUATION SCORES

| DBMS | Score (10 Perfect) | Weighted Score (30%) | Remarks |
|---|---|---|---|
| ADABAS-M | 2 | 0.6 | |
| BASIS | 7 | 2.1 | |
| IDM-500 | 5 | 1.5 | 1 |
| DMS-1100 | 8 | 2.4 | |
| SQL/DS | 5 | 1.5 | |
| RAPPORT | 5 | 1.5 | |
| SIBAS | 5 | 1.5 | |
| S-2000 | 0 | 0.0 | 2 |
| MRDS | 0 | 0.0 | 3 |

1. Table lookups, cross referencing.

2. Absence of validity checking in documentation indicates absence of capability.

3. Dangerous situation in MRDS. Fields left blank on input are filled by following data, causing possibility of serious contamination of data base

Component - 3.3 Reorganization

| DBMS | Physical | Logical |
|---|---|---|
| ADABAS-M | Yes | No |
| BASIS | No | No |
| IDM-500 | No | No |
| DMS-1100 | Yes | Yes |
| SQL/DS | Yes | Yes |
| RAPPORT | Yes | Yes |
| SIBAS | Yes | Yes |
| S-2000 | Yes | Yes |
| MRDS | No | Yes |

Scoring Procedures

The elements of this component were graded objectively as follows:

Physical = 6 if present
Logical = 4 if present

This allocation was based on the assumption that frequent bulk loading of high volume data (e.g., terrain, climate) would require physical reorganization.

## REORGANIZATION EVALUATION SCORES

| DBMS | Score (10 Perfect) | Weighted Score (10%) | Remarks |
|---|---|---|---|
| ADABAS-M | 6 | 0.6 | |
| BASIS | 0 | 0.0 | NO DATA AVAILABLE |
| IDM-500 | 0 | 0.0 | NO DATA AVAILABLE |
| DMS-1100 | 10 | 1.0 | |
| SQL/DS | 10 | 1.0 | |
| RAPPORT | 10 | 1.0 | |
| SIBAS | 10 | 1.0 | |
| S-2000 | 10 | 1.0 | |
| MRDS | 4 | .4 | |

Component - 3.4 Monitoring

| DBMS | File Statistics | System Performance |
|---|---|---|
| ADABAS-M | Yes | Yes |
| BASIS | Yes | No |
| IDM-500 | No | No |
| DMS-1100 | Yes | Yes |
| SQL/DS | Yes | Yes |
| RAPPORT | Yes | No |
| SIBAS | Yes | No |
| S-2000 | Yes | Yes |
| MRDS | No | Yes |

Scoring Procedure

The elements of this component were graded with equal weight. The grading of each element was subjective based upon the reviewer's perception of their comprehensiveness.

MONITORING EVALUATION SCORES

| DBMS | Score (10 Perfect) | Weighted score (10%) | Remarks |
|---|---|---|---|
| ADABAS-M | 6 | 0.6 | 1 |
| BASIS | 5 | 0.5 | 2 |
| IDM-500 | 0 | 0.0 | 3 |
| DMS-1100 | 7 | 0.7 | 4 |
| SQL/DS | 6 | 0.6 | |
| RAPPORT | 4 | 0.4 | |
| SIBAS | 4 | 0.4 | |
| S-2000 | 7 | 0.7 | 5 |
| MRDS | 5 | 0.5 | |

1. Report warns DBA of limits being approached. Thread and run statistics.

2. Command use frequencies, summaries and other averages.

3. OEM vendor can implement reports.

4. Many Reports

5. Many Reports

Component - 4.1 Documentation and Vendor Aids

| DBMS | Manuals | Vendor Training | Vendor Assistance |
|---|---|---|---|
| ADABAS-M | DBA, Installation, Application Programmer | Yes | Yes |
| BASIS | DDL, Reference, Utilities Programmers, Thesaurus, Report | Yes | Yes |
| IDM-500 | Software Reference Manual | Yes | Yes |
| DMS-1100 | Schema, Sub-Schema, COBOL DDL, FORTRAN DDL, PL/1 DDL, System Support, Operator, Summary, Abstract | Yes | Yes |
| SQL/DS | Concepts and Facilities | Yes | Yes |
| RAPPORT | User, COBOL User, Designing and Using Database, Interactive Query Language | See Remark | See Remark |
| SIBAS | User, DBA, Installation | Yes | No Data |
| S-2000 | Define and Access, PLEX, Messages and Codes, Support, Report Writer, Syntax | Yes | Yes |
| MRDS | DBA Guide, MRDS Reference Manual, LINUS Reference Manual, MRPG Reference Manual | Yes | Yes |

Scoring Procedure

The elements of this component were graded with equal weight. Grades were assigned subjectively based upon comprehensiveness of documentation and clarity of presentation, and on degree of training and assistance promised.

DOCUMENTATION AND VENDOR AIDS EVALUATION SCORES

| DBMS | Score (10 Perfect) | Weighted Score (80%) | Remarks |
|---|---|---|---|
| ADABAS-M | 7 | 5.6 | |
| BASIS | 4 | 3.2 | |
| IDM-500 | 4 | 3.2 | 1 |
| DMS-1100 | 8 | 6.4 | |
| SQL/DS | 2 | 1.6 | 2 |
| RAPPORT | 4 | 3.2 | |
| SIBAS | 4 | 3.2 | 3 |
| S-2000 | 7 | 5.6 | 4 |
| MRDS | 7 | 5.6 | |

1. BRITTON-LEE offers classes in both hardware and software for IDM-500. OEM vendor may offer training and assistance.

2. Additional manuals will become available concurrent with (or before) release of SQL/DS. IBM normally will supply assistance when requested.

3. No formal training or assistance function, but the vendor assured sufficient training and assistance.

4. System-2000 offers 9 classes on scheduled basis and 3 video tape courses.

Component - 4.2 Portability

| DBMS | Implementation Language | UNIVAC 1100 | Other Computers |
|---|---|---|---|
| ADABAS-M | Assembly | No | VAX-11, PDP-11, IBM |
| BASIS | FORTRAN | Yes | IBM, CDC, DEC |
| IDM-500 | N/A | Summer 82 | See Remark |
| DMS-1100 | No Data | Yes | UNIVAC 90 |
| SQL/DS | No Data | No | IBM 43XX, 30XX |
| RAPPORT | FORTRAN | Yes | See Remark |
| SIBAS | FORTRAN | Yes | IBM, DEC-10, CDC, ND-10, PRIME |
| S-2000 | No Data | Yes | IBM, CDC |
| MRDS | PL/1 | No | Honeywell |

Scoring Procedure

The elements of this component were judged according to their combined "Portability" potential, with those already available for the UNIVAC 1100 earning extra points even if they were not portable to other machines. ADABAS-M, DMS-1100 and SQL/DS lost points due to a perceived reluctance of their vendors to transport them to additional manufacturer machines. RAPPORT scored highest due to the claim of complete vendor support in transporting to new machines.

PORTABILITY EVALUATION SCORES

| DBMS | Score (10 Perfect) | Weighted Score (20%) | Remarks |
|---|---|---|---|
| ADABAS-M | 1 | 0.20 | |
| BASIS | 8 | 1.6 | |
| IDM-500 | 7 | 1.4 | 1 |
| DMS-1100 | 6 | 1.2 | |
| SQL/DS | 1 | 0.2 | |
| RAPPORT | 10 | 2.0 | 2 |
| SABIS | 8 | 1.6 | |
| S-2000 | 7 | 1.4 | |
| MRDS | 2 | 0.4 | |

1. Any computer which supports RS-232 or GPIB interface. Two OEM vendors plan to deliver UNIVAC version during summer of 1982.

2. Implemented on many computers. LOGICA will install RAPPORT on virtually any machine as part of the license price.

## O V E R A L L  E V A L U A T I O N  S C O R E S

| | ADABAS-M | BASIS | IDM-500 | DMS-1100 | SQL/DS | RAPPORT | SIBAS | S-2000 | MRDS |
|---|---|---|---|---|---|---|---|---|---|
| USER/APPLICATION | 6.40 | 4.90 | 6.60 | 4.90 | 9.70 | 8.50 | 2.80 | 9.70 | 7.00 |
| Weight = 20% | 1.28 | 0.98 | 1.32 | 0.98 | 1.94 | 1.70 | 0.56 | 1.94 | 1.40 |
| SYSTEM CONTROL | 7.00 | 4.50 | 5.75 | 6.75 | 8.75 | 8.25 | 6.25 | 8.00 | 2.50 |
| Weight = 15% | 1.05 | 0.68 | 0.86 | 1.01 | 1.31 | 1.24 | 0.94 | 1.20 | 0.38 |
| ADMINISTRATIVE | 4.30 | 4.10 | 5.00 | 6.60 | 7.10 | 4.40 | 4.90 | 3.70 | 4.90 |
| Weight = 50% | 2.15 | 2.05 | 2.50 | 3.30 | 3.55 | 2.20 | 2.45 | 1.85 | 2.45 |
| OTHER | 5.80 | 4.80 | 4.60 | 7.60 | 1.80 | 5.20 | 4.80 | 7.00 | 6.00 |
| Weight = 15% | 0.87 | 0.72 | 0.69 | 1.14 | 0.27 | 0.78 | 0.72 | 1.05 | 0.90 |
| TOTAL WEIGHTED SCORE | 5.35 | 4.43 | 5.37 | 6.43 | 7.07 | 5.92 | 4.67 | 6.04 | 5.13 |

3.2.4 Conclusions and Recommendations

3.2.4.1 Discussion of Results

Examination of the Overall Evaluation Scores shows a clear victory for SQL/DS. Although the difference in total score between SQL/DS (7.07) and the runner-up, DMS-1100 (6.43) is not dramatic, other factors must be taken into consideration which in effect widen the gap. The major factor is that the SQL/DS score has been significantly handicapped by its poor showing in the "OTHER" category, which includes "Documentation and Vendor Aids" and "Portability". The low score in this category is due to the fact that SQL/DS is a newly released system implemented at Beta test sites and documentation has not yet caught up with development. When documentation does become available for SQL/DS, there is no reason to assume that it will be inferior to IBM's usual documentation quality, which is excellent. If one were to assume for the moment that SQL/DS could be said to score as high as DMS-1100 in this category, it would score an overall 7.94 points.

The relational implementation of SQL/DS, with its anticipated ease-of-use, is another point in its favor, making SQL/DS even more attractive. If there were no other consideration, SQL/DS would unambiguously be the winner.

3.2.4.2 Recommendations

Two negative factors must be considered by the Army before committing to SQL/DS. The first factor is that of technical risk. SQL/DS is not yet a completely released product. Although the vendor claims a high degree of satisfaction at the Beta test sites, one must remember that it is the vendor who is talking. Since, for policy reasons, we were denied access to the users we have no way of calibrating the vendor's statements. Since not even IBM is immune to technical risk, the Army should keep this consideration in mind.



151

The second, obvious negative factor pertaining to a decision on SQL/DS is that of cost. SQL/DS will not be portable to UNIVAC hardware. The adoption of this DBMS will include the cost of replacing existing UNIVAC hardware and existing application software. It would seem that the apparent benefits of SQL/DS over DMS-1100, while significant, are not so overwhelming as to justify incurring such a cost. There may be other considerations outside the purview of this study, however, which may be moving the Army toward a reappraisal of hardware. That lacking, we recommend that the second place DBMS, DMS-1100 be adopted as the AMIP DBMS. The functionality and power of DMS-1100 are certainly more than adequate for the job at hand. There are, however, nagging doubts concerning its ease of use. The difficulty of data base design in a CODASYL data model are acknowledged. Two apparent manifestations of its difficulty have surfaced during this investigation. During Task 1 investigations it was discovered that an attempt had been made to convert a model to DMS-1100 and was abandoned. This may be a symptom of difficulty of use. In two user interviews it was stated that applications were written for System 2000 if at all possible. Only if the job could not be done on System 2000 would the users resort to DMS-1100. This indicates both the difficulty of use of DMS-1100 and its superior power.

3.2.4.3 Postscript

Before ending this study, we feel that special mention should be made of the IDM-500. This device represents the most advanced data base management technology currently available on the market. In our estimation a solid product has been implemented, which is not always the case on the leading edge of technology. While there are undoubtly kinks still in the IDM-500, we have been impressed, during our several meetings with Britton-Lee personnel and study of their documentation, with the completeness of their design and their apparent frankness concerning design or implementation difficulties. Although the Data Base Accelerator

option is behind schedule, they seem to be quite open about discussing its delay, which gives one the impression that they are reasonably confident of imminent success.

We feel that the IDM-500 should be kept in view for the future. Its main attractiveness is its expected ability to increase data throughput by at least one order of magnitude while at the same time offloading much of the data management responsibility from the host general purpose computer. While we have stated that performance efficiency is not an important issue to the AMIP, it may be that in the future it will be an issue due to either the presence of other applications on the computers being used to run the models, or to a future desire to make the models more rapidly interactive.

Another potential significant benefit of the IDM-500 is that it can support standardization and centralization of the AMIP data base, should these objectives be pursued. With appropriate interface development, the IDM-500 is eminently transportable to any host computer. Moreover, should the Army decide to centralize the models data base, a single IDM-500 could, theoretically, provide data base management for all of the model computers.

## EVALUATION CRITERIA DEFINITIONS

BULK LOAD
Ability to load large amounts of data from non-DBMS files into DBMS files by special procedures that are faster than performing many single record additions.

RELATIONAL OPERATORS
Ability to qualify data records based upon the contents of data elements within them.

BOOLEAN OPERATORS
Ability to form complex qualification statements by connecting relational operators with Boolean statements such as AND and OR.

HOST LANGUAGE INTERFACE
Ability to call the services of the DBMS from a programming language.

SORTED RESULTS
Ability to retrieve data in an order specified by the user.

BUILT-IN SUMMARY FUNCTIONS
Ability to summarize collections of data by built-in functions such as COUNT, AVERAGE, MINIMUM.

NON-PROCEDURAL LANGUAGE
A language which requires no looping or branching.

REPORT GENERATOR
A facility for requesting printed reports in a format specified by the user.

STORED QUERY
Ability to save a string of query commands for repeated use.

AUDIT LOG
A record of updates made to the data base.

SAVE/RESTORE
Ability to dump the contents of the data base onto removable storage and copy it back.

UPDATE ROLLBACK
Ability to restore the data base to a state comensurate with the last successful update.

ANSACTION ROLLBACK
Ability to restore the data base to a state commensurate with the last successful transaction comprised of a user defined set of updates.

LEVEL OF SHARED ACCESS
Depth to which multiple users can concurrently access the same data (file, record, field, etc.).

MULTI-USER
Ability for multiple users to access the DBMS concurrently.

MULTI-THREADING
The overlapping of service requests on secondary storage devices.

DEADLOCK PROVISIONS
Provisions to either avoid or correct a condition where two routines each have records locked which the other needs to access before it can proceed.

LEVEL OF PROTECTION
The depth to which access authorization can be denied (e.g., file, record, element, etc.).

READ PERMISSION
Permission to read a specified collection of data.



154

WRITE PERMISSION
[illegible] to write to a specified collection of data. This includes add and update operations.

PASSWORD
Ability to store passwords for use in certifying users' authority to access data.

SELF CONTAINED
A language implemented under the DBMS.

SCHEMA CAPABILITY
The ability to store user provided definitions of data format and structure under control of the DBMS.

SUB-SCHEMA CAPABILITY
The ability to store subsets of schemas for specific applications of users.

USER VIEW CREATION
The ability of users to create their own sub-schems.

USER QUERY DICTIONARY
The ability of users to request information concerning data base characteristics.

USER UPDATE DICTIONARY
The ability of users to create or modify schemas.

FORMAT CHECK
Incoming data is rejected if and the user is notified if it does not conform to the format specified in the schema.

RANGE CHECK
Incoming data is rejected and the user is notified if it does not fall within range limits specified in the schema.

LEGAL LIST
Specified incoming data items are rejected and the user is notified if their value does not appear in a list of specified legal vaues residing in the schema.

UNIQUENESS CHECK
Specified incoming data items are rejected and the user is notified if their values are equal to values of the element already in the data base.

REQUIRED ELEMENT
Incoming records are rejected if specified data items are missing.

PHYSICAL REORGANIZATION
Ability to physically rearrange data for increased access efficiency or reduced storage requirements without affecting user programs.

LOGICAL REORGANIZATION
Ability to rearrange the logical connections, subordinations, and groupings of data without affecting user programs.

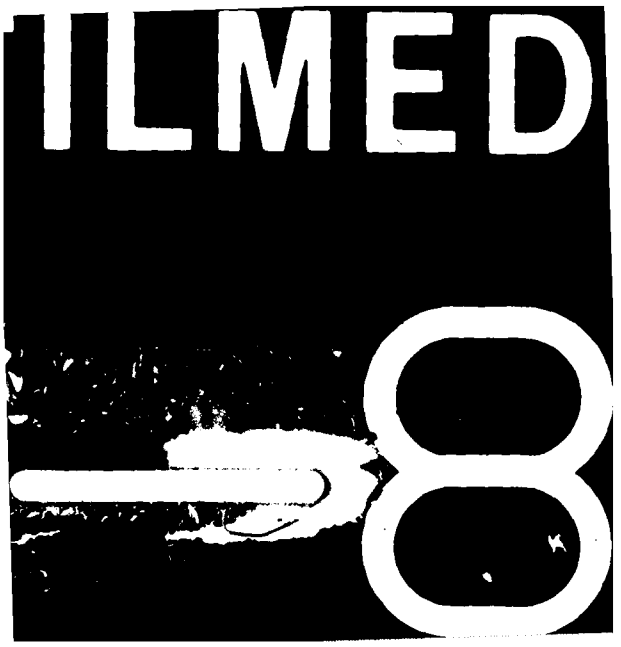
FILE STATISTICS MONITORING
Ability to ascertain and report on the status of the DBMS files, such as number of records, percent filled, etc.

SYSTEM PERFORMANCE MONITORING
Ability to ascertain and report on the current status and/or performance of the system, such as number of users, number of I/Os, etc.

VENDOR TRAINING
The existence of formal classroom training in the use of the DBMS.

VENDOR ASSISTANCE
Access to vendor technical personnel for assistance with difficult problems of data base design or use.

IMPLEMENTATION LANGUAGE
The programming language in which the DBMS was implemented.


ILMED
8